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Control No.: 09/898,205 PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent of:	Peter Wenzel and Serge Manning
Application Number:	09/898,205
Filed:	July 3, 2001
For:	Continuation Session Attribute
Group Art Unit:	2681
Examiner:	Moore, Ian N.

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPEAL BRIEF FILED BY ASSIGNEE APPELLEE
UNDER 37 C.F.R. § 41.31

The Assignee of Record, Nortel Networks, Ltd., hereby files this Appeal Brief pursuant to 37 C.F.R. §41.31, which appeals the basis of the claim rejections in the Final Office Action mailed on September 20, 2005 by the application Examiner. Appellee, Nortel Networks, Ltd. filed a Notice of Appeal received by the United States Patent and Trademark

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Office on January 23, 2006. Appellee believes the Examiner's final rejection is improper because essential claim limitations are not disclosed, taught or suggested by any of the prior art relied upon by the Examiner. In fact, the cited prior art operates in the same manner as the "Prior Art" described in the specification, which was distinguished from the present invention. Further, the prior art cannot be combined to achieve the claimed invention, and the Appellee believes that the drawings are adequate and acceptable under the patent office's rules and regulations and the alleged deficiency in the drawings is not required by these rules and regulations. For the foregoing reasons, the Examiner's Final Rejection should be reversed.

I. Real Party in Interest (37 C.F.R. §41.37(c)(1)(i))

The real party in interest in this patent application examination is the Assignee of Record, Nortel Networks, Ltd., as reflected by assignment records at Reel/Frame 012167/0736. A copy of the assignment record is attached hereto in the Appendix as *Exhibit 1*.

II. Related Appeals and Interferences (37 C.F.R. §41.37(c)(1)(ii))

There are no other appeals or interferences relating to the present reexamination application.

III. Status of Claims (37 C.F.R. §41.37(c)(1)(iii))

Claims 1-20 are pending in this patent application, and each of those claims stand as finally rejected as noted in the Final Office Action mailed September 20, 2005. *See Exhibit 4, Final Office Action.*

IV. Status of Amendments (37 C.F.R. §41.37(c)(1)(iv))

No amendments have been filed or entered after the Final Office Action was mailed on September 20, 2005.

V. Summary of the Claimed Subject Matter (37 C.F.R. §41.37(c)(1)(v))

A. The Problem Addressed By the Claims

Typically, a mobile node (*e.g.* cellular phone, pager, etc.) is permanently associated with an assigned home network and maintains an Internet Protocol (IP) address associated with the home network. As a mobile node changes its point of attachment to the network, (be it the home network or a foreign network), the mobile node maintains connectivity to its home network. That is, a home network continues to transmit information packets to the mobile node even when the mobile node is located on another network, i.e. a foreign network.

Routers are used to regulate the flow of data through this computer network. Routing tables are maintained on a router and contain the information necessary for a router to make a determination of where to route an information packet. A router interprets the logical address of an information packet, which typically contains an IP address, and directs the information packet to its intended destination.

When located on the home network, the routers on the home network will route information packets addressed to the mobile node internal to the home network. When the mobile node travels to a foreign network, the mobile node will be assigned a temporary IP address corresponding to its location on the foreign network for the transmission of information packets to the mobile node.

Proving one's claimed identity is referred to as authentication, and security systems and protocols on a mobile IP network often require authentication of the user's identity before authorizing a requested activity. In this situation, specialized servers authenticate, authorize and collect accounting information for services rendered to the mobile node while visiting a foreign network. This authentication, authorization, and accounting activity is called "AAA", and AAA servers on the home and foreign network perform these specialized AAA activities.

When a mobile node roams through a foreign network, the wireless connection of the mobile node to the foreign network transitions from one base station (or packet control function) to another. When the base station transition occurs on the foreign network, certain prior art protocols de-allocate the temporary mobile node address and initiate a new multi-part communication session by re-allocating a new temporary IP address to the mobile node.

In a multipart communication session, such as ongoing communication while roaming across cellular boundaries, this de-allocation and re-allocation of a new address can cause an erroneous assignment of the same address to another mobile node, which can disrupt proper communications and the accounting function for the mobile node resulting in errors and problems in billing and accounting. When the de-allocation of the IP address occurs, information packets addressed to the mobile node may also be misdirected or lost. De-allocation of temporary address of the mobile node during a multipart session can also disrupts routing, accounting, and billing for the mobile node. Thus, there is a need for a solution to the de-allocation and re-allocation of temporary IP addresses when the mobile node is roaming on a foreign network.

B. The Solution Embodied in the Present Application

The invention claimed in the present application (hereinafter also referred to as "the '205 Application") solves these problems by preventing de-allocation of the temporary address assigned to the mobile node, allowing the mobile node to maintain its connectivity by a single temporary IP address in a multipart communication session. The invention uses a continuation session attribute imbedded in a message sent to the communication server to control the allocation of addresses for the mobile node during the mobile node's multipart communication session, and this continuation session attribute prevents de-allocation of the mobile node address and permits a continued connectivity of the mobile node to the foreign network. *Exhibit 2, '205 Application.*

When operating within a cellular site, an IP address temporarily assigned to the mobile node controls routing of information packets between the mobile node and its home network. However, the mobile node can continue to roam around the wireless network, and in doing so, the mobile node may move between adjacent cellular sites changing its physical connectivity to the network. Under the prior art, when such movement occurs, the wireless connection to the mobile node terminates with a new wireless connection initiated. This movement and the reconnection on the wireless network is called a wireless transition. *Exhibit 2, '205 Application, p. 8, ln. 1-ln 18.*

1. The Packet-Based Communication System

The present invention solves the de-allocation problems by using a new message format and protocol that prevents the de-allocation of the temporary IP address, which allows for a "continued session" to be maintained by the mobile node. *Exhibit 2, '205 Application,*

p. 8, ln 19-p. 9, ln 4. Figures 2 and 5 and the corresponding description in the specification for Figure 5 set forth the invention and one possible embodiment for implementation.

As presented below, an example is provided wherein a mobile node (64) transitions to a foreign radio network (60).

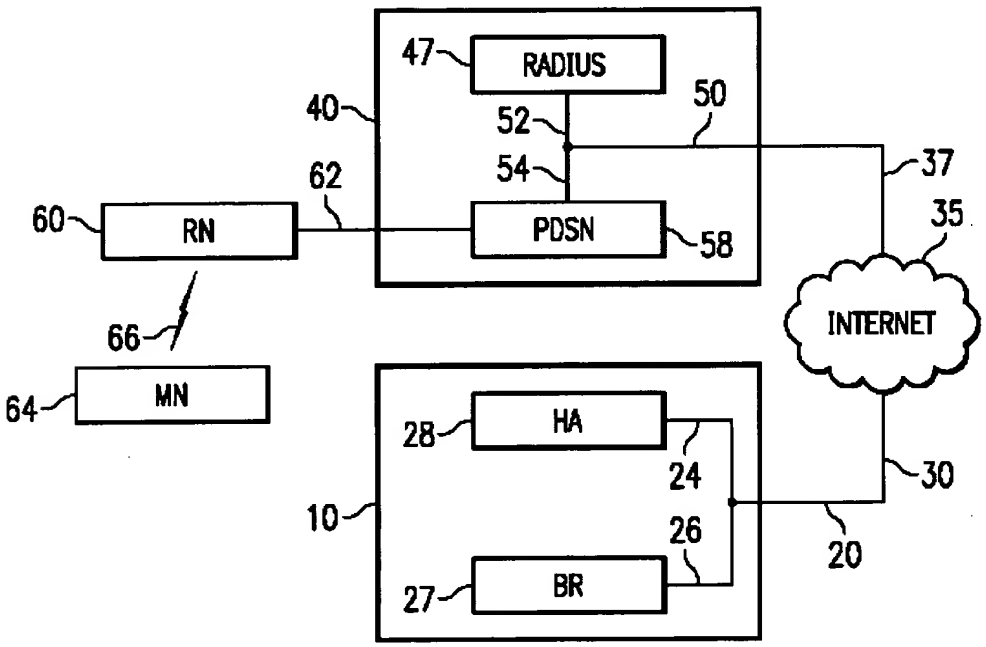


FIG. 2

2. The Set-Up of the Mobile Node on a Foreign Network

Referring concurrently to Figures 2 and 5 of the present application (reproduced on this and the next page, respectively), in step 405 the mobile node 64 transmits a Link Control Protocol negotiation message to the Packet Data Serving Node (PDSN) 58 to establish a R-P Interface 62 between the PDSN 58 and the RN 60. After establishing the R-P interface 62, the mobile node 64 authenticates its identity by sending an authentication message with a user-name to the PDSN 58 at step 410. The PDSN 58 sends an Access Request message

with the user name to the RADIUS server 47 at step 415, which also contains additional information about the mobile node 64 such as a user password, destination port, client ID, or other information. *Exhibit 2, '205 Application, p. 11, ln 3-19.*

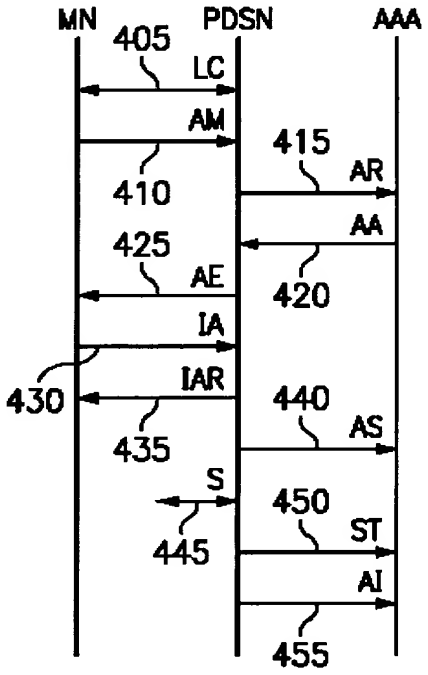


FIG. 5

The RADIUS server 47 processes the Access Request message (AR) to determine if the mobile node 64 is authorized access to the network 40. If the mobile node 64 is authorized access to the network, the RADIUS server 47 generates and transmits Access Accept (AA) message to the PDSN 58 at step 420.

The allocation of an IP address by the RADIUS server 47 also occurs at step 420. In this embodiment, the RADIUS server 47 manages, allocates, and maintains a pool of dynamic IP addresses to assign to mobile nodes on the foreign network 40. The network uses the assigned IP addresses to route information packets to the Mobile Node 64 and

accomplish AAA functions. The PDSN 58 will use the IP address to locate the mobile node 64 on the RN 60 and direct information packets to the appropriate base stations on the RN 60 to communicate with the mobile node 64. *Exhibit 2, '205 Application, p. 11, ln 20 – p. 12, ln 8.*

In step 425, the PDSN 58 responds to the Access Accept message by generating and transmitting an Authentication End message to the Mobile Node 64. If the mobile node 64 is not authorized by the RADIUS server 47, an Access Reject message is instead generated transmitted to the PDSN 58 to terminate the attempted communication.

After successfully linking to the home network 10, a communication session can begin. To begin accounting by the RADIUS server 47, the Mobile Node 64 transmits an Initial Accounting message to the PDSN 58 at step 430. The PDSN 58 responds at step 435 with a response message to the Mobile Node 64. The PDSN 58 also generates and transmits an Accounting Start message to the RADIUS server 47 to start the accounting functions at step 440, completing the setup for the accounting process for the packet data communication session.

3. The Specific Problem

The PDSN 58 accomplishes the remaining communication session tasks and linkages establishing a connection over the Internet 35 with the Home Network 10 so that the communication session takes place at step 445 with the message packet interactions between the Mobile Node 64 and the PDSN 58, the Home Network 10, and any other networks. *Exhibit 2, '205 Application, p. 12, ln 9 – p. 13, ln 2.* The problem the invention addresses arises when mobility events occur, such as the handoff of the mobile node from one base

station to another on the foreign network. Under the prior art, when such a mobility event occurs, the PDSN 58 transmits an Accounting Stop message at step 450 followed by an Accounting Start message at step 455. The Accounting Stop message at step 450 causes the RADIUS server 47 to de-allocate the assigned IP address from the Mobile Node 64 interrupting connectivity. The Accounting Start message at step 455 should re-allocate the IP address back to the Mobile Node 64, but this does not always occur as the RADIUS server 47 erroneously allocates the IP address to another node before receipt of the Accounting Start message at step 455. Such a de-allocation could cause an erroneous assignment of the same IP address to another mobile node. This erroneous assignment stemming from the interrupted connectivity can disrupt proper communications and accounting for the mobile node. *Exhibit 2, '205 Application, p. 13, ln 3-25.*

4. The Specific Solution In the Present Invention

To prevent this problem, the present invention attaches a new continuation session attribute to the Accounting Stop message transmitted at step 450, referred to as a Continuation Session Attribute. This Continuation Session Attribute overrides the de-allocation of the temporary IP address such that the RADIUS server 47 does not to de-allocate the mobile node's IP address. Specifically, the specification states:

> When an Accounting Stop message is received by the RADIUS server 47 at step 450, the Continuation Session Attribute 500 attached thereto will indicate to the RADIUS server 47 that the Accounting Stop message is not the end of the communication session, but the Accounting Stop message will be followed by an Accounting Start message that will continue the communication session. This attribute 500 will instruct the RADIUS server 47 not to deallocate the mobile node's IP address, and as such, the multipart communication session will not be erroneously interrupted by a premature deallocation of the IP address.

Exhibit 2, p. 14, ln. 17-25).

The allocated IP address is never de-allocated by the server, and all the problems associated with de-allocation and subsequent re-allocation of a temporary IP address to the mobile node are prevented from occurring. For instance, the present invention prevents any disruption to the multipart communication session by continuing the routing connectivity and the accounting for the multipart communication session without any errors. *Exhibit 2, '205 Application, p. 14, ln 1 – p. 15, ln 4.*

The invention claims require that a network "continue" a communication session without interruption. As used in the specification, the concept of "continue" requires a continuation of the connectivity for information packet routing and accounting functions. Necessarily, the concepts of "continue" and "continuation" as associated with a multipart communication session for a mobile node means "not de-allocating" the mobile node address and continue routing connectivity.

All of the independent claims embody this concept of "continue," "continuation," "session continuation," or "continuation session" - preventing (e.g. stopping) the de-allocation of an assigned IP address to the mobile node. This is the central precept of the use of these terms in the specification. Under the invention found in the claims, properly interpreted in light of the specification, the temporary assigned address is never de-allocated during the multipart communication session (i.e. continues routing and accounting connectivity).

VI. Issues (37 C.F.R. §42.37(c)(1)(vi))

A. Is the rejection of Claims 1, 7-11, and 18 under 35 U.S.C. §102(e) as unpatentable over Jakobsen '108 well-founded and correct?

B. Is the rejection of Claims 2-5, 12-17, and 19-23 under 35 U.S.C. § 103(a) as unpatentable over Jakobsen '108 in view of Yoshida '365 well-founded and correct?

C. Is the rejection of Claim 6 under 35 U.S.C. § 103(a) as being unpatentable over Jakobsen '108 in view of Tari '491 well-founded and correct?

D. Is the objection to the drawings well-founded?

For convenience, the Appellee has provided copies of the Final Office Action and the foregoing cited art in the attached Appendix as follows: Exhibit 4, Final Office Action, Exhibit 5, Jakobsen '108 (U.S. Patent No. 6,374,108), Exhibit 6, Yoshida '365 (U.S. Patent 5,570,365), and Exhibit 7, Tari '491 (U.S. Patent No. 6,542,491).

VII. Argument (37 C.F.R. §42.37(c)(1)(vii))

A. Summary of the Rejection

In the Final Office Action in the examination application, the Examiner rejected all claims (Claims 1-20) in the pending U. S. Patent Application No.09/898,205 (hereafter "the '205 Application"). Claims 1, 7-11, and 18 were rejected under 35 U.S.C. §102(e) as being unpatentable over U.S. Patent 6,374,108 to Jakobsen et al (hereafter "Jakobsen '108," *Exhibit 5*). Claims 1, 9, and 18 are the independent claims. Dependent Claims 2-5, 12-17, and 19-23 were also rejected under 35 U.S.C. § 103(a) as being unpatentable over Jakobsen '108 in view of U.S. Patent 5,570,365 to Yoshida (hereafter "Yoshida '365," *Exhibit 6*). Dependent Claim 6 was also rejected under 35 U.S.C. § 103(a) as being unpatentable over Jakobsen

'108 in view of U.S. Patent 6,552,491 to Tari et al. (hereafter "Tari '491, *Exhibit 7*). The Examiner also objected to the drawings, because several acronyms lacked direct correlation to a full description of the acronym within the specification.

B. Responses to Final Rejection Bases

As shown in the Final Office action attached at *Exhibit 4*, the Examiner primarily relies upon the Jakobsen '108 reference to disclose almost all the claimed elements, including the claim limitation of "maintaining allocation of an IP address or continuing an accounting function for an ongoing communication session." *Exhibit 4, Final Office Action, p. 7.* The rejection of all independent Claims 1, 9, and 18 are based solely on Jakobsen '108.

Each of the independent claims require: (1) the transmission of a control message that denotes the continuation of a communication session (Claim 1), (2) the transmission of a session continuation message for maintaining an address allocation (Claim 9), or (3) the transmission of a session continuation message for continuing an accounting function in an on-going communication session (Claim 18). *Exhibit 3, Response to First Office Action, Amended Claims, 1, 9 and 18.* This is the continuation session aspect of the invention described in the specification, and distinguished from de-allocation and subsequent re-allocation of a temporary IP address to the mobile node as described in the "Prior Art."

The Examiner relies upon Yoshida '365 and Tari '491 to disclose other claimed features in combination with Jakobsen '108, but the Examiner relies exclusively upon Jakobsen '108 to disclose the continuation of an on-going communication session without the interruption of a de-allocation or a re-allocation of a mobile node address. *Exhibit 4, Final Office Action, p. 5-6.* Because essential claimed subject matter is not disclosed, taught or

suggested in Jakobsen '108 alone or as combined with the other references cited by the Examiner, the Assignee of Record respectfully requests that all the rejections against the claimed subject matter be reversed, and that all the claims of the '205 Application be allowed to issue or that further Examination in accordance with guidance from the Board be ordered.

1. The Jakobsen '108 Patent Does Not Prevent De-Allocation/Re-Allocation of a Mobile Node Addresses as Claimed

In Jakobsen '108, a Software and Measurement Infrastructure (SwMI) controls the allocation of IP addresses to mobile stations operating in the network and the routing of communication (e.g. information packets) among the mobile agents in the network. The SwMI also performs other agent functions on its network. Accounting functions, however, are not one of the disclosed functions for the SwMI. *Exhibit 5, Jakobsen '108, col. 1, ln. 39-57.*

When a SwMI allocates an IP address to a mobile node, a mobile node must perform "context activation" before the mobile node can start sending and receiving communication using IP addressing. *Exhibit 5, Jakobsen '108, col. 2, ln. 53-63.* During a mobile node hand-off within a network governed by the Jakobsen '108 system, the mobile node address is "de-allocated" and then the mobile node address is "re-allocated" to the same mobile node by new equipment on the network. Referring to Figure 4 below, Jakobsen '108 operates as follows:

> SwMI 300, acting as a first controller for cell 350 of the first network of the cellular radio communications system, is adapted to receive a request from the mobile station 374 that the cellular radio communication system assign to mobile station 374 the static IP address previously assigned to the mobile station outside of cell 350. If mobile station 374 had passed directly from cell 210 to cell 350, then the request from mobile station 374 to SwMI 300, acting

as foreign, agent, would be for the same IP address as mobile station 374 had been using in cell 210.

SwMI 300 is further adapted, in response to the request from mobile station 374, to check with SwMI 200 associated with cell 210 that the static IP address requested has not been assigned to another mobile station. Although in this example mobile station 374 has passed directly from cell 210 to cell 350, in general SwMI 300 is adapted to check with the controller of the cell in the location where the mobile station was previously registered. This may have been another foreign agent for mobile station 374, not shown on FIG. 4.

Finally, SwMI 300 is adapted to assign the static IP address previously assigned to mobile station 374, outside of cell 350, to mobile station 374 for use in cell 350, if the static IP address has not been assigned to another mobile station. Registration with the Home Agent of SWMI 300 allows the forwarding of data packets to the SWMI 300 by tunnelling through the network. It is possible that the IP address previously assigned to mobile station 374, outside of cell 350, has been assigned by SwMI 200 to another mobile station, and is therefore no longer available to be assigned by SwMI 300 for use in cell 350. It is also possible that another mobile station already within cell 350 has been given the IP address previously used by mobile station 374, and that for this reason the IP address previously assigned to mobile station 374 is no longer available for assignment by SwMI 300 to mobile station 374 for use in cell 350.

Exhibit 5, Jakobsen '108, col. 6, ln. 4-39 (emphasis added).

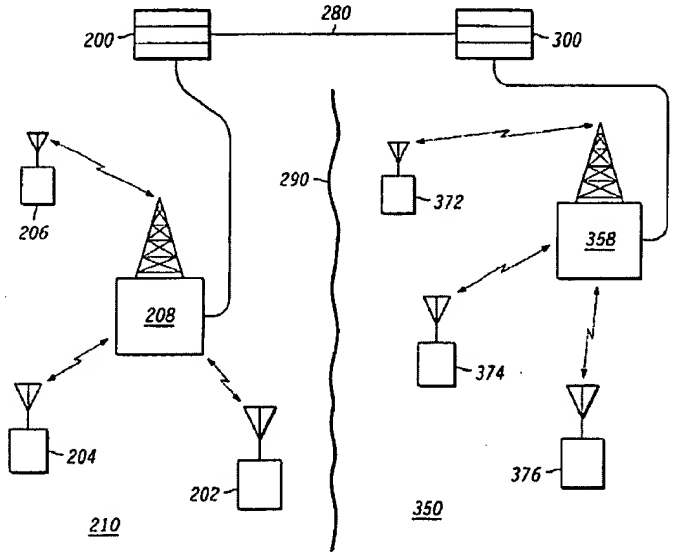


FIG. 4

In Jakobsen '108, the server assigns IP addresses with two possible outcomes: 1) the network may recognize the mobile station and allocate the same static IP address previously assigned to that mobile node (i.e. static addressing) if it is available, or 2) the network assigns any IP address to the mobile node currently not in use from a pool of available IP addresses (i.e. dynamic address allocation). In dynamic address allocation, the SwMI maintains a pool of IP addresses for use in dynamic allocation. *Exhibit 5, Jakobsen '108, col. 3, ln. 18-29.*

The mobile node's request message for an address in Jakobsen '108 does no more than request assignment of the same static IP address previously assigned. *Exhibit 5, Jakobsen '108, col. 6, ln. 4-9.* Nothing in Jakobsen '108 suggests, teaches, or discloses a request message preventing de-allocating the IP address for an on-going continuation communication session. Finally, a visited SwMI requires the performance of a registration; i.e. no continuation of the routing connectivity or accounting but rather discontinuing or interrupting the connectivity. *Exhibit 5, Jakobsen '108, col. 6, ln. 4-39 and Figure 5.* The term "previously assigned" in Jakobsen '108 necessarily requires de-allocating the IP address and interrupting connectivity.

Moreover, "the IP address previously assigned to [the] mobile station" can be "assigned by SwMI 200 to another mobile station, and is therefore no longer available to be assigned...." *Exhibit 5, Jakobsen '108, col. 6, ln. 29-34.* Additionally, another mobile node within the cell controlled by the SmWI 300 can be assigned the IP address previously used by the mobile node making the IP address unavailable. *Exhibit 5, Jakobsen '108, col. 6, ln. 34-39.* As such, one of the problems solved by the present invention (preventing

misaddressing during de-allocation) is specifically recognized as being present in Jakobsen '108.

As such, Jakobsen '108 simply requests a single static address for the mobile node, which may or may not be available anymore after a prior de-allocation of the mobile node address, and it does not prevent the de-allocation/re-allocation scenario or the problems solved by the present invention. This primary reference does not: (1) transmit a data element that denotes the continuation of a communication session as claimed (Claim 1), (2) transmit a session continuation message for maintaining an address allocation as claimed (Claim 9), or (3) transmit a session continuation message for continuing an accounting function in an on-going communication session as claimed (Claim 18). *Exhibit 3, Response to First Office Action, Amended Claims, 1, 9 and 18.* These continuation session aspects of the invention are claimed features that distinguish the present invention from Jakobsen '108 and the "Prior Art."

Jakobsen '108 does not operate to prevent de-allocation; it only operates to request the re-allocation of the same IP address previously allocated but currently not allocated (if available). In a multipart communication session, the de-allocation in Jakobsen '108 interrupts or "discontinues" connectivity which can disrupt routing, accounting, and billing, and preventing this problem is the underlying purpose of the invention in the '205 Application. Further, Jakobsen '108 does not even disclose the accounting functions required to maintain an anticipation contention for Claim 18.

2. Jakobsen '108 Does Not Operate Analogous to the Invention

Contrary to the Examiner's rejection, there is no "communication server computer

controlling the allocation of addresses for the mobile node and performing accounting functions" as claimed by the '205 Application. *See Exhibit 2, '205 Application, Claim 1.* The Jakobsen '108 network does not function by "receiving [a] request message from [a] serving computer and maintaining an address for a mobile node on the foreign network." *See Exhibit 2, '205 Application, Claim 9.* Jakobsen '108 also fails to disclose "continuing an accounting function for a mobile node address on an ongoing communication session after receipt of [a] continuation session message." *See Exhibit 2, '205 Application, Claim 18.* Finally, Jakobsen '108 does not teach a "session continuation data element" as defined and used by the specification and claimed. *See Exhibit 2, '205 Application, Claims 5, 16, 17, and 23.*

According to the Examiner's analysis, Jakobsen '108 "discloses assigning/allocating 'static' or 'same' IP address which is previously used is assigned in the new cell, thereby, continuing the service, and the packets can be forward to the mobile by means of tunneling...which is analogous to applicant claimed invention of 'a continuation session data element, maintaining allocation of an IP address or continuing an accounting function for an ongoing communication session.'" *Exhibit 4, Final Office Action, p. 8.* This analysis concluding analogous operation is not correct.

Jakobsen '108 does not operate analogous to the invention. First, Jakobsen '108 operates by always de-allocating the IP address during a hand-off or re-introduction of the mobile node onto the network, which does not support a continuation of an on-going communication session. As such, Jakobsen '108 operates with the same deficiency identified in the prior art – possible misaddressing of the mobile node and non-availability of a static

address. Because Jakobsen '108 always de-allocates the IP address, it cannot be correctly stated that Jakobsen '108 operates analogously to the claimed invention by always continuing connectivity for routing and accounting when in fact Jakobsen '108 operates to always interrupt (i.e. discontinue) connectivity possibly disrupting routing and accounting if addresses are no longer available.

Second, various claim elements, which will be further detailed below, are missing in Jakobsen '108. For example, Jakobsen '108 does not include a communication server computer controlling the allocation of IP addresses and performing the accounting functions. *Exhibit 4, Final Office Action, p. 7.* Jakobsen '108 does not disclose or mention an accounting feature.

C. The Examiner Does Not Give Appropriate Weight To the Use of Claim Terms in the Specification When Interpreting the Claims

Central to the operation of the invention, and a correct interpretation of the claims, is the concept of "continue," "continuing," and "continuation." The Manual of Patent Examining Procedure (MPEP) states essentially that the "pending claims must be "given *>their< broadest reasonable interpretation consistent with the specification." *MPEP §2111* (August 2005). More properly however, when interpreting claims during patent examination, the claims are "given their broadest reasonable interpretation consistent with the specification, and ....claim language should be read in light of the specification as it would be interpreted by one of ordinary skill in the art." *In re Academy of Science Tech Center,* 367 F.3d 1359 (Fed. Cir. 2004) (*quoting In re Bond,* 910 F.2d 831, 833 (Fed. Cir. 1990))

(*emphasis added*). *See also Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en blanc*).

An inventor is permitted to act as his own lexicographer. A term can be imbued "special meaning" sufficiently clear so as to be understood by one skilled in the art. *MPEP § 2111.01.III* (August 2005) (*citing In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994)). Where an explicit definition is provided by the Appellee, the claim term must be interpreted according to that definition. *MPEP §2111.III* (August 2005)(*citing Toro Co. v. White Consolidated Industries, Inc.*, 199 F.3d 1295, 1301 (Fed. Cir. 1999)). Words and terms in the claims are interpreted according to the context of use in the specification and the drawings. *Id.*

As long as a claim term is sufficiently clear within the context of the specification and drawings to be understood by someone of experience in the art, that plain meaning of the claim should be used even if it departs from the norm. *Id.* (*citing Multiform Desiccants Inc. v. Medzam Ltd.*, 133 F.3d 1473, 1477 (Fed. Cir. 1998) and *Process Control Corp. v. HydReclaim Corp.* 190 F.3d 1350, 1357 (Fed. Cir. 1999)). The meaning of a particular claim term may be defined by usage of the term in the context of the specification. This definition can be by implication, and there is no requirement for explicit definitions or clear disavowal of claim scope. *MPEP § 2111.01.III* (August 2005) (*citing Phillips v. AWH Corp.*, 415 F.3d 1303, 75 USPQ2d 1321 (Fed. Cir. 2005) (*en banc*) and *Vitronics Corp v. Conceptronic, Inc.*, 90 F.3d 1576, 1583 (Fed. Cir. 1996)).

In *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (*en blanc*), the Federal Circuit reemphasized the importance of the specification in claims construction both by the

courts and by the USPTO. Usage within the specification is the predominant consideration. As noted by the Federal Circuit, "the specification may reveal a special definition given to a claim term by the patentee that differs from the meaning it would otherwise possess." *Id.* (*quoting CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3f, 1359, 1366 (Fed. Cir. 2002)). The USPTO determines the scope of the claims by "giving claims their broadest reasonable construction 'in light of the specification as it would be interpreted by one of ordinary skill in the art.'" *Id.* (*quoting In re Academy of Science Tech Center,* 367 F.3d 1359, 1364 (Fed. Cir. 2004)(emphasis added)). The Federal Circuit also quoted the following:

> It is the person of ordinary skill in the field of the invention through whose eyes the claims are construed. Such person is deemed to read the words used in the patent document with a understanding of their meaning in the field, and to have knowledge of any special meaning and usage in the field. The inventor's words that are used to describe the invention – the inventor's lexicography – must be understood and interpreted by the court as they would be understood and interpreted by a person in that field of technology. Thus the court starts the decision process by reviewing the same resources as would that person, viz., the patent specification and the prosecution history. *Multiform Desiccants, Inc. v. Medzam, Ltd.,* 133 F.3d 1473, 1477 (Fed. Cir. 1998) (*citing Medrad., Inc. v. MRI Devices Corp.*, 401 F.3d 1313, 1319 (Fed. Cir. 2005))

Importantly, no claim terms require an express definition. Terms defined by implication are just as binding as terms explicitly defined on both the courts and the USPTO. *Phillips v. AWH Corp.*, 415 F.3d 1303 (*citing Vitronic*, 90 F.3d at 1582, *Irdeto Access, Inc. v. Echostar Satellite Corp.*, 383 F.3d 1295 (Fed. Cir. 2004); *Novartis Pharms. Corp. v. Abbott Labs*, 375 F.3d 1328, 1334-1335 (Fed. Cir. 2004) *("Even when guidance is not provided in explicit definitional format, the specification may define claim terms by implication such that the meaning may be found in or ascertained by a reading of the patent documents"*); and *Bell*

Atl. Network Servs., Inc. v. Covad Communications Group, Inc., 262 F.3d, 1258, 1268 (Fed. Cir. 2001)).

It is the Applicants' position that the Examiner is not properly following the Federal Circuit's and MPEP's guidelines to give the claims proper weight and interpretation as used in the specification. The interpretation by the Examiner of the claims is overly broad and unreasonable in light of the specification, particularly as to the concept embraced by the terms "continue," "continuing," and "continuation." Moreover, when considering the Jakobsen '108 prior art reference, the Examiner makes too broad an interpretation of the patent's teaching to impermissibly read upon the claimed invention.

The independent claims 1, 9, and 18 all use the terms "continuation," "continuing," "session continuation message," or "continuation session message." The Examiner appears to be misconstruing these terms away from their plain meaning as defined by the specification. This misunderstanding of the usage is evident in the Examiners rebuttal of Appellees' arguments in the Response to First Office Action, wherein the Examiner states the following:

> One skill in the ordinary art would clearly see that when "mobile station" in the new cell is assigned with the "same", "static", or "previous" IP address from the old cell, it is a "continuation of the mobile's communication session" since the same/static/ previous address is continued to use. *Exhibit 4, Final Office Action, p. 8.*

The Examiner is obviously construing "de-allocation" and "re-allocation" to be the same as "continuing" an "on-going" communication session through Jakobsen '108, even though Jakobsen '108 acknowledges that the static "previous" address may not be available to the requesting mobile node.

The claim terms "continue," "continuing," "session continuation message," or "continuation session message" have a plain meaning as defined in light of the repeated descriptions in the specification as follows:

> When the deallocation of the IP address occurs, information packets addressed to the mobile node may be misdirected or lost. Other problems, such as billing and accounting difficulties, may be encountered after a premature deallocation of the IP address. *Exhibit 2, '205 Application, p. 6, ln 1-9.*
>
> When a mobile node's wireless connection transitions from one base station (or packet control function) to another, the mobile node may want to maintain its connectivity to the network. This continued network connection allows the mobile node to continue to transmit and receive information packets in a multipart session. In order to prevent the premature deallocation of the mobile node's IP address in a multipart session, the present invention supports the use of a new message format and protocol for extending the time prior to a deallocation of the IP address. The new message format includes the addition of an attribute to an accounting message that will cause the AAA server to recognize the mobile node's desire to maintain connectivity to the network in a multipart session. In response to the new message format attribute, a AAA server will not deallocate the IP address for the mobile node, and the same IP address can be used for the mobile node after the transition of a wireless connection. *Exhibit 2, '205 Application, p. 6, ln 11-25.*
>
> The present invention solves the premature deallocation problem by attaching a new message attribute 150 to the Accounting Stop message transmitted to the RADIUS server 47 at step 450. The new attribute 150 is called a Continuation Session Attribute, and its format is shown at 500 in Figure 6. *Exhibit 2, '205 Application, p. 14, ln 1-5.*
>
> When an Accounting Stop message is received by the RADIUS server 47 at step 450, the Continuation Session Attribute 500 attached thereto will indicate to the RADIUS server 47 that the Accounting Stop message is not the end of the communication session, but the Accounting Stop message will be followed by an Accounting Start message that will continue the communication session. This attribute 500 will instruct the RADIUS server 47 not to deallocate the mobile node's IP address, and as such, the multipart communication session will not be erroneously interrupted by a premature deallocation of the IP

> address. When the Accounting Start message containing the correlating Identifier is then received by the RADIUS server 47, the accounting process for the communication session of mobile node 64 will continue without interruption or error. *Exhibit 2, '205 Application, p. 14, ln 18 - p. 15, ln 1-3.*
>
> Deallocation of a mobile node's IP address during a multipart communication session on a foreign network can cause serious communication and accounting errors. The new message format and protocol should eliminate the premature deallocation of a mobile node's IP address, which should reduce associated communication and accounting errors. *Exhibit 2, '205 Application, Abstract, p. 21.*

The present invention supports a reliable continuation of a communication session by preventing de-allocation of the mobile node address – which is claimed in the invention. Jakobsen '108, however, can make no such representation. Rather than "continuing" connectivity in a multipart communication session by not de-allocating the mobile node address, the Jakobsen '108 reference interrupts, or "discontinues," connectivity during a multipart communication session by de-allocating the mobile node address, the very antithesis of the claimed invention.

D. The Rejection of the Dependent Claims 2-8, 10-17, and 19-23 Under 35 U.S.C. §103(a) Are Traversed Because It is Believed the Independent Clams 1, 9, and 18 Are Allowable When Properly Interpreted

Independent Claims 1, 9, and 18 are believed allowable, because the sole basis for rejecting these independent claims, Jakobsen '108, fails to teach, suggest, or disclose the claimed limitations in light of the usage in the specification. Since the dependent claims add further limitations to the limitations of the allowable independent claims, the dependent claims are likewise allowable and render the § 103(a) rejections of the dependent claims moot.

E. The Drawings Are Acceptable Under the Applicable Regulations and According to the MPEP

The Examiner objected to the drawings because "the full description of the acronym, which directly correlated with acronym/label used in the drawing, should be clearly defined in the specification." The term "acronym" is not found in the applicable section of the MPEP. *See MPEP §608.02* (August 2005) The Examiner does not more definitively explain why the drawings are deficient, and the Appellee has not been able to locate the identified requirement for the specified direct correlation in either the MPEP or the Combined Federal Regulations (CFR).

The element number designations in the specification and the drawings required for understanding the drawings and the specification clearly define and identify the correlating steps containing the same element number designations (i.e. reference characters) in the specification, which appears to be the only requirement of both the MPEP and the CFR. *See MPEP §608.02V* (August 2005) and *37 C.F.R. §1.84(p)*. The acronyms are not "reference characters" as understood by the Appellee and in that sense are superfluous for an understanding of the drawings and not otherwise barred by either the MPEP or CFR. Furthermore, the acronyms are clear enough in light of the specification to be interpreted by any person skilled in the art. The Appellee does not believe this objection is correct without a more definite explanation for the objection by the Examiner.

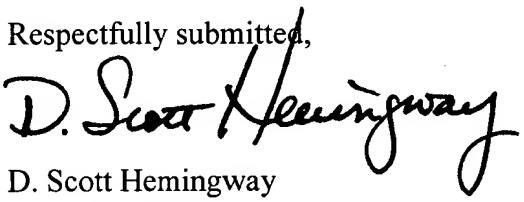
F. Conclusion

The Appellee respectfully requests reversal of the claim rejections in the examination in light of the remarks. By these remarks, the Appellee believes the Examiner's 35 U.S.C. §§

102(e) and 103(a) rejections have been traversed because essential elements of the claimed invention are not disclosed, taught, or suggested in Jakobsen '108, or any combination of Jakobsen '108 with the other references cited by the Examiner.

This appeal brief is filed with a fee of $500.00. It is believed that no additional fees are necessary for this filing. If additional fees are required for filing this response, then the appropriate fees should be deducted from D. Scott Hemingway's Deposit Account No. 501,270.

Respectfully submitted,



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VIII. Appendix (37 C.F.R. §1.192(c)(9))

Appendix of Claims
Appendix of Evidence

Exhibit 1	Assignment Record
Exhibit 2	The '205 Application
Exhibit 3	Response to First Office Action
Exhibit 4	Final Office Action
Exhibit 5	Jakobsen '108 Patent
Exhibit 6	Yoshida '365 Patent
Exhibit 7	Tari '491 Patent

APPENDIX OF CLAIMS

CLEAN VERSION OF CLAIMS AFTER AMENDMENTS

1. (Original) A communications system, comprising:

a radio network coupled to a serving computer on a first network;

a mobile node coupled to the radio network by a wireless communication link;

a communication server computer linked to the serving computer, said communication server computer controlling the allocation of addresses for the mobile node and performing accounting functions for the first network, and;

a control message transmission on the first network comprising a data element that denotes the continuation of the mobile node's communication session on the first network.

2. (Original) The communications system in Claim 1 wherein the control message includes a type field.

3. (Original) The communications system in Claim 1 wherein the control message includes a length field.

4. (Original) The communications system in Claim 1 wherein the control message includes a vendor-type field.

5. (Original) The communications system in Claim 1 wherein the control message includes a field containing the data element.

6. (Original) The communications system in Claim 1 wherein the serving computer is coupled to an Internet.

7. (Original) The communications system in Claim 1 wherein the serving computer is coupled to a second network.

8. (Original) The communication system in Claim 1 wherein the communication server computer will not change the mobile node's address on the foreign network after receiving the control message.

9. (Original) The method of continuing a communication session on a communication system comprising the steps of:

transmitting a request message from a serving computer to a first serving computer, said request message contains a session continuation message; and

receiving the request message from said serving computer and maintaining an address allocation for a mobile node on the foreign network.

10. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message is a data element in an accounting message.

11. (Original) The method of continuing a communication session in Claim 9 wherein the server computer continues accounting functions for an ongoing communication session in response to the request message.

12. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes a type data element.

13. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes a length data element.

14. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes a vendor-type data element.

15. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes an identifier data element.

16. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes a session continuation attribute data element.

17. (Original) The method of continuing a communication session in Claim 16 wherein the session continuation attribute is a data value in an accounting message.

18. (Amended) A method for supporting communications on packet-based network comprising the steps of:

receiving a continuation session message, and,

continuing an accounting function for a mobile node address on an ongoing communication session after receipt of the continuation session message.

19. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes a type data element.

20. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes a length data element.

21. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes a vendor-type data element.

22. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes an identifier data element.

23. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes a session continuation attribute data element.

APPENDIX OF EVIDENCE

UNITED STATES PATENT AND TRADEMARK OFFICE

NOVEMBER 20, 2001

PTAS

THE LAW OFFICES OF D. SCOTT HEMINGWAY
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RECORDATION DATE: 09/17/2001

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BRIEF: ASSIGNMENT OF ASSIGNOR'S INTEREST (SEE DOCUMENT FOR DETAILS).

ASSIGNOR:
WENZEL, PETER W.

DOC DATE: 06/29/2001

ASSIGNOR:
MANNING, SERGE

DOC DATE: 08/27/2001

ASSIGNEE:
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SERIAL NUMBER: 09898205
PATENT NUMBER:

FILING DATE: 07/03/2001
ISSUE DATE:

SHAREILL COLES, EXAMINER
ASSIGNMENT DIVISION
OFFICE OF PUBLIC RECORDS

09-20-2001

101849702

To the Assistant Commissioner for Pate ... or copy thereof.

1. Name of conveying party(ies):

Peter W. Wenzel
Serge Manning

9-17-01

Additional name(s) and address(es)? ___ Yes _X_ No

2. Name and Address of receiving party(ies):

Name: NORTEL NETWORKS LIMITED

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380 St. Antoine Street West, 8th Floor

City: Montreal,

State: Quebec Canada H2Y 3Y4

Additional name(s) & address(es) attached? ___ Yes _X_ No

3. Nature of Conveyance:

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4. Application number(s) or patent number(s).

Serial No. 09/898,205

___ This document is being filed together with a new application.

Title: **CONTINUATION SESSION ATTRIBUTE**
Filing Date: **07/03/01**
Docket No: P1016

A. Patent Application No.(s)
09/898,205

Additional numbers attached? _____ Yes _X_ No

B. Patent No.(s)

Additional numbers attached? _____ Yes _X_ No

5. Name and address of party to whom correspondence concerning document should be mailed:

Name: D. Scott Hemingway
The Law Offices of D. Scott Hemingway

Address: Preston Commons West, Suite 800
8117 Preston Road

City: Dallas

State: TX Zip: 75225

6. Number of applications and patents involved: 1 utility patent application.

40 E

7. Amount of fee enclosed or authorized to be charged: $40

8. Deposit Account No: 501270
This form is submitted in duplicate.

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9/11/01
Date

D. Scott Hemingway (Reg. No. 36,360)

Total Number of Pages Including Cover Sheet, Attachments, and Document: 3

12850RRUS02U

ASSIGNMENT

WHEREAS, the undersigned inventor(s), hereinafter called the "Assignor", has invented a new and useful invention entitled:

CONTINUATION SESSION ATTRIBUTE

for which reference a full description is here made in an application for Letters Patent of the United States filed herewith.

WHEREAS, NORTEL NETWORKS LIMITED, a Canadian company having a principal office and place of business at, World Trade Center of Montreal, 380 St. Antoine Street West, 8th floor, Montreal, Quebec H2Y 3Y4, Canada hereinafter called the "Assignee", is desirous of acquiring the entire right, title and interest in and to said invention, the application above identified, and in, to and under Letters Patent which may be obtained for said invention, as hereinafter more fully set forth;

NOW, THEREFORE, TO ALL WHOM IT MAY CONCERN, be it known that for valuable and legally sufficient consideration, the receipt of which by the Assignor from the Assignee is hereby acknowledged, the Assignor has sold, assigned and transferred, and by these presents does sell, assign and transfer unto the Assignee, its successors and assigns, the entire right, title and interest in and to the invention and the application herein above identified, and all Letters Patents that may issue for the said invention, and all divisions, reissues, substitutions, continuations, and extensions thereof, to have and to hold for the sole and exclusive use and benefit of the Assignee, its successors and assigns to the full end of the term for which any and all of said Letters Patents for the said invention may issue.

FURTHER, be it known that the Assignor has sold, assigned and transferred, and by these presents does sell, assign and transfer unto the Assignee, its successors and assigns, the entire foreign rights to the invention disclosed in said application, in all countries of the world, including the right to file applications and obtain patents under the terms of the International Convention for the Protection of Industrial Property, and of the European Patent Convention, and further agrees to execute any and all patent applications, assignments, affidavits, and any other papers in connection therewith necessary to perfect such patent rights.

And the Assignor does hereby covenant and agree, for himself and his legal representatives, that they will assist the Assignee in the prosecution of the application herein identified; in the making and prosecution of any other applications for Letters Patent that the Assignee may elect to make covering the invention herein identified, as hereinbefore set forth, including any application for reissue, application for reexamination, application for foreign patent rights, or any proceeding in the United States Patent and Trademark Office affecting the invention, investing in the Assignee exclusive title in and to all such other applications and Letters Patent; and in the prosecution of any interference which may arise involving said invention, or any application or Letters Patents herein contemplated; that they will promptly execute and deliver to the Assignee any and all additional papers and make all lawful oaths which may be requested by the Assignee to fully carry out the terms of this assignment; and further that they will communicate to Assignee, or to its successors, assigns, and legal representatives, any facts known respecting said invention, and at the expense of the Assignee, testify in any legal proceedings, and generally do everything possible to aid the Assignee, its successors, assigns and nominees to obtain and enforce proper patent protection for said invention in all countries.

And the Commissioner of Patents and Trademarks is hereby authorized and requested to issue all Letters Patent to the Assignee in accordance with the terms of the assignment.

IN TESTIMONY WHEREOF, the Assignor has hereunto set his hands on the date indicated below.

Dated: 6/29/01

Peter W. Wenzel

Date: 6/29/01

Witness: Jerry Mizell

(print name)

12850RRUS02U

Dated: 8/27/01

Serge Manning

Date: 8/27/01

Witness: Dawn R. Wiggers

DAWN R. WIGGERS

(print name)

CONTINUATION SESSION ATTRIBUTE

INVENTORS:

Peter W. Wenzel
Serge Manning

"Express Mail"mailing label No. EK443954561US

Date of Deposit: July 3, 2001

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D. Scott Hemingway
(Typed or printed name of person mailing paper or fee)

(Signature of person mailing paper or fee)

EXHIBIT

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CONTINUATION SESSION ATTRIBUTE

Prior Application Data

This application is related to Provisional Application No. 60/215,747 filed July 6, 2000.

Technical Field of the Invention

A message format and communication protocol for an IP mobility system.

BACKGROUND OF THE INVENTION

Present-day Internet communications represent the synthesis of technical developments begun in the 1960s. During that time period, the Defense Department developed a communication system to support communications between different United States military computer networks, and later a similar system was used to support the communication between research computer networks at United States universities. These technological developments would subsequently revolutionize the world by forming the basic elements of the Internet.

The Internet

The Internet, like so many other high tech developments, grew from research originally performed by the United States Department of Defense. In the 1960s, Defense Department officials wanted to connect different types of military computer networks. These different computer networks could not communicate with each other because they used different types of operating systems or networking protocols.

While the Defense Department officials wanted a system that would permit communication between these different computer networks, they realized that a centralized interface system would be vulnerable to missile attacks and sabotage. To avoid this vulnerability, the Defense Department required that the interface system be decentralized with no vulnerable failure points.

The Defense Department developed an interface protocol for communication between these different network computers. A few years later, the National Science Foundation (NSF) wanted to connect different types of network computers located at research institutions across the

country. The NSF adopted the Defense Department's interface protocol for communication between these research computer networks. Ultimately, this combination of research computer networks would form the foundation for today's Internet.

Internet Protocols

The Defense Department's interface protocol was called the Internet Protocol (IP) standard. The IP standard now supports communications between computers and networks on the Internet. The IP standard identifies the types of services to be provided to users, and specifies the mechanisms needed to support these services. The IP standard also describes the upper and lower system interfaces, defines the services to be provided on these interfaces, and outlines the execution environment for services needed in the system.

One basic rule governing communications on the Internet is the requirement that a computer user does not need to get involved with details of each communication. In order to accomplish this goal, the IP standard imposes a layered communications structure. All the layers are located on each computer in the network, and each module or layer is a separate component that theoretically functions independent of the other layers.

Two types of transmission protocols may operate with the IP protocol – the Transmission Control Protocol (TCP) or the User Datagram Protocol (UDP). TCP was developed to provide connection-oriented, end-to-end data transmission between packet-switched computer networks, and UDP supports a connection-less transmission between computer networks. Unlike UDP, TCP provides certain error recovery and data-checking

services. The combination of TCP or UDP with the IP protocol forms a suite of protocols for communication between computers on the Internet.

This suite of protocols form a standardized system for defining how data should be processed, transmitted and received on the Internet. These protocols also define the network communication process, and more importantly, defines how a unit of data should look and what information an information packet message should contain so that the receiving computer can receive the information message and interpret it properly.

Routing

Routers are used to regulate the flow of data through a computer network. A router interprets the logical address of an information packet, such as an IP address, and directs the information packet to its intended destination. Information packets addressed between computers on the same network are not allowed to pass outside the network, while information packets addressed to a computer outside the network are allowed to pass to that computer on the outside network.

A routing table possesses sufficient information for a router to make a determination on whether to accept the communicated information packet on behalf of a destination computer or pass the information packet onto another router on the network. The routing table also permits the router to determine where the information should be forwarded within the network. A Visitor Location Register (VLR) and Home Location Register (HLR) are two examples of such routers. A routing table can be configured manually with routing table entries or dynamically according to changing network topologies – network architecture, network structure, layout of routers, and interconnections between hosts and routers.

Authenticate, Authorize and Accounting ("AAA")

In an IP-based mobile communications system, the mobile communication device (*e.g.* cellular phone, pager, etc.) can be generically called a mobile node. Typically, a mobile node changes its point of attachment to the network while maintaining connectivity to its home network. That is, a home network continues to transmit information packets to the mobile node even when the mobile node is located on another network, sometimes referred to as a foreign network. While the mobile node is coupled to the foreign network, the mobile node will be assigned an IP address for the transmission of information packets.

When a mobile node is operating on a foreign network, specialized servers must authenticate, authorize and collect accounting information for services rendered to the mobile node. This authentication, authorization, and accounting activity is called "AAA", and AAA servers on the home and foreign network perform the AAA activities.

Authentication is the process of proving someone's claimed identity, and security systems on a mobile IP network will often require authentication of the system user's identity before authorizing a requested activity. The AAA server authenticates the identity of an authorized user, and authorizes the mobile node's requested activity. Additionally, the AAA server will also provide the accounting function including tracking usage and charges for use of the network.

A mobile node is assigned an IP address while it conducts a communication session on the foreign network. When a mobile node roams through a foreign network, the wireless connection of the mobile node to the foreign network may transition from one base station (or

packet control function) to another. When the transition of the wireless connection occurs, certain prior art protocols send accounting messages to the AAA server that initiate the deallocation of the mobile node's IP address. This deallocation of the IP address may be unintentional because the mobile node intends to continue its communication session while it roams the network. When the deallocation of the IP address occurs, information packets addressed to the mobile node may be misdirected or lost. Other problems, such as billing and accounting difficulties, may be encountered after a premature deallocation of the IP address.

SUMMARY OF THE INVENTION

When a mobile node's wireless connection transitions from one base station (or packet control function) to another, the mobile node may want to maintain its connectivity to the network. This continued network connection allows the mobile node to continue to transmit and receive information packets in a multipart session. In order to prevent the premature deallocation of the mobile node's IP address in a multipart session, the present invention supports the use of a new message format and protocol for extending the time prior to a deallocation of the IP address. The new message format includes the addition of an attribute to an accounting message that will cause the AAA server to recognize the mobile node's desire to maintain connectivity to the network in a multipart session. In response to the new message format attribute, a AAA server will not deallocate the IP address for the mobile node, and the same IP address can be used for the mobile node after the transition of a wireless connection.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the invention will become more readily understood from the following detailed description and appended claims when read in conjunction with the accompanying drawings in which like numerals represent like elements and in which:

Fig. 1 is a schematic diagram of cellular sites on a mobile IP wireless communications network;

Fig. 2 is a schematic diagram of a mobile IP wireless communications network;

Fig. 3 is a general format for a UDP datagram;

Fig. 4 is a general format for an attribute in a UDP datagram;

Fig. 5 is a step diagram for the authentication and accounting functions on a foreign network;

Fig. 6 is a new message format for an attribute to an Accounting Stop.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In Figure 1, cellular site 65 is shown in a mobile IP network. In cellular site 65, mobile node 64 is coupled to base station 69 via wireless connection 66. The base station 69 is coupled to the base station controller 75 via connections 70 and 71. Cellular site 68 has a base station 73 to support wireless connections in that cellular site. Base station 73 is coupled to the base station controller 75 via connections 72 and 71. Cellular site 67 has a base station 74 to support wireless connections in that cellular site. Base station 74 is coupled to the base station controller 75 via connections 75 and 71.

The base station controller 75 is coupled to a foreign network 40 via communication line 76. The foreign network 40 is coupled to the Internet 36 via communication line 39. The terms base station or base station controller can be referred to as a base station transceiver, packet control function or base station subsystem. The term foreign network can be referred to as visited network.

When operating within cellular site 65, the mobile node 64 communicates through a wireless connection 66 to base station 69. The mobile node communicates with the Internet 36 through the base station controller 75 and the foreign network 40. When communicating on the foreign network 40, the mobile node 64 is assigned a specific IP address. The mobile node 64, however, may roam around the wireless network shown in Figure 1. In so doing, the mobile node 64 may leave the cellular site 65 and enter the cellular site 68. When such movement occurs, the wireless connection 66 will terminate, and a new wireless connection between mobile node 64 and base station 73 will be initiated. This movement and the reconnection on the wireless network is called a wireless transition.

After a wireless transition occurs, the AAA servers in the foreign network 40 will receive control messages that will cause the deallocation of the IP address assigned to the mobile node 64. The mobile node 64, however, will need to maintain the same IP address if it wants to maintain consistent connectivity with the outside networks on the Internet 36. If a deallocation of the IP address occurs, information packets addressed to the mobile node 64 may be lost or misdirected. Further, accounting errors may occur based upon the deallocation and reallocation of the former IP

address to another mobile node. The present invention solves the premature deallocation problem with a new message format and protocol for use with AAA servers.

Figure 2 shows a diagram of a wireless IP mobility network having the mobile node 64, a foreign network 40, a home network 10, and the Internet 35. The mobile node 64 is linked to a radio network (RN) 60 by a wireless communication link 66. The RN 60 is linked to the foreign network 40 via communication link 62, sometimes called the R-P interface. The foreign network 40 has a foreign agent, also referred to as a Packet Data Serving Node (PDSN) 58.

PDSN 58 is coupled to RN 60 via communication link 62. PDSN 58 is coupled to a foreign network buss line 50 by communication link 54. The foreign network 40 includes a AAA server, also referred to as a RADIUS server 47, which is coupled to buss line 50 via communication link 52. The foreign network 40 is coupled to the Internet 35 by communication link 37.

The home network 10 is coupled to the Internet 35 by communication link 30. The home network 10 has a central buss line 20 that is coupled to communication link 30. Home network 10 has a AAA server 27 coupled to buss line 20 by communication link 26. Home agent 28 is linked to the central buss line 20 by communication link 24.

The communication protocol used by the IP mobility system shown on Figures 1 and 2 uses a User Datagram Protocol ("UDP") with the IP standard. As shown in Figure 3, a standard UDP datagram for an accounting message format 100 is used in the present invention, and message 100 includes a code field 110 of one byte in length. The code

110 identifies the type of RADIUS packet as an accounting message, either request or response. For an Accounting Request message the code 110 will have a value of 4, and for an Accounting Response message the code 110 will have a value of 5.

The accounting message format 100 also has an identifier data field 120 of one byte in length. The identifier data 120 is used to assist with the identification of corresponding accounting requests and responses. The accounting message format has a length field 130 of two bytes in length to indicate the length of the entire accounting message 100 including the code 110, identifier 120, length 130, authenticator140, and all attribute fields 150.

The message format 100 includes an authenticator field 140 that is 16 bytes in length. The authenticator field 140 is used to authenticate the message between the PDSN 58 and the AAA RADIUS server 47. The attribute field 150 of accounting message 100 is variable in length and contains messages involved with the authentication, authorization, and accounting operations for the mobile node's 64 connectivity to foreign network 40 and other networks.

In message format 100, the format for the attribute field 150 is shown in Figure 4. The three data structures in the attribute field 150 include the type field 210 (designated by "T") which occupies the first 8 bits of the attribute field 150, the length field 220 (designated by "L") which occupies the next 8 bits of the attribute field 150, and the data field 230 (designated by "D") which occupies the remaining bits in the attribute field 150. The type field 210 indicates the particular type of attribute in the attribute field 150, and the length field 220 indicates the length in

bytes of the attribute field 150. The data field 230 may be zero or more bytes in length, and sets forth the applicable data that is being transmitted.

In a communication session involving the mobile node 64 on the foreign network 40, the mobile node 64 initiates a packet data session by contacting the RN 60 over communication link 66. The RN 60 in turn establishes communication with PDSN 58 over communication link 62. As shown in Figure 5, the first communication from the mobile node 64 to the PDSN 58 is a Link Control Protocol negotiation message at step 405. The negotiation message at step 405 establishes an R-P Interface 62 between the PDSN 58 and the RN 60.

After the contact is established between the mobile node 64 and the PDSN 58, it is necessary to authenticate the identity of the mobile node 64. The mobile node 64 sends an authentication message with a user-name to the PDSN 58 at step 410. The PDSN 58 then sends an Access Request message with the user name to the RADIUS server 47 at step 415. The Access Request message at step 415 contains information about the mobile node 64 including information such as a user password, destination port, client ID. Other information may be provided in the Access Request message.

The RADIUS server 47 processes the information in the Access Request message to determine if the mobile node 64 is authorized to access the network 40. If the mobile node 64 is authorized, the RADIUS server 47 generates an Access Accept message. The Access Accept message is transmitted to the PDSN 58 at step 420.

The RADIUS server 47 maintains a pool of dynamic IP addresses for assignment to mobile nodes on the foreign network 40. The IP

addresses are used to route information packets to the Mobile Node 64 and accomplish AAA functions. This pooling of IP addresses is managed at the RADIUS server 47. This allocation of an IP address by the RADIUS server 47 occurs when the Access Accept message is generated and sent to the PDSN 58 at step 420. The PDSN 58 will use the IP address to locate the mobile node 64 on the RN 60 and direct information packets to the appropriate base stations on the RN 60 for communication with the mobile node 64.

In response to the Access Accept message, the PDSN 58 generates an Authentication End message that is transmitted to the Mobile Node 64 at step 425. If the mobile node 64 is not authorized by the RADIUS server 47, an Access Reject message is transmitted to the PDSN 58 to terminate the attempted communication with the mobile node 64.

Once the Mobile Node 64 is successfully linked to the home network 10 and the data packet communication session can begin, the RADIUS server 47 will begin accounting for the mobile node's usage of the foreign network 40 resources. The mobile node 64 sends an initial accounting message IPCP to the PDSN 58 at step 430. The PDSN 58 responds to the mobile node 64 with a response at step 435. The PDSN 58 will generate and transmit an Accounting Start message to the RADIUS server 47 to start the accounting functions. The PDSN 58 transmits the Accounting Start message to the RADIUS server 47 at step 440.

This will complete the setup for the accounting process for the packet data communication session. The remaining communication session tasks and linkages are accomplished by the PDSN 58 establishing a connection over the Internet 35 with the Home Network 10. The

communication session takes place at step 445 by the interactions between the mobile node 64 and the PDSN 58, and any other networks.

At the end of the communication session, the PDSN 58 is notified of the communication termination and transmits an Accounting Stop message from the PDSN 58 to the RADIUS server 47. The Accounting Stop message is transmitted at step 450. In response to the Accounting Stop message at step 450, the mobile node's IP Address is deallocated back into the pool for subsequent allocation to another mobile node.

A problem can arise when certain mobility events occur, such as the handoff of control over the mobile node's wireless communication from one base station to another. When such a mobility event occurs, the PDSN 58 may transmit an Accounting Stop message to the RADIUS server 47 at step 450 followed by an Accounting Start message to the RADIUS server at step 455. The combination of the Accounting Stop message at step 450 and the Accounting Start message at step 455 is meant to indicate that the mobile user is continuing the communication in a multipart communication session.

As part of a multipart communication session, the mobile node's IP address should not be deallocated. The RADIUS server 47, however, may still deallocate the mobile node's IP address in response to the Accounting Stop message at step 450 before it has an opportunity to consider the Accounting Start message at step 455. Such a deallocation could cause an erroneous assignment of the same IP address to another mobile node. This erroneous assignment could disrupt proper communications and the accounting function for the mobile node.

The present invention solves the premature deallocation problem by attaching a new message attribute 150 to the Accounting Stop message transmitted to the RADIUS server 47 at step 450. The new attribute 150 is called a Continuation Session Attribute, and its format is shown at 500 in Figure 6. The type field 510 in Continuation Session Attribute 500 is assigned a value of 26 for Vendor-Specific for all attributes. The Length field 520 in attribute 500 is the length of all the data fields (in bytes) in the attribute.

The Vendor-ID field 530 is the same for all attributes, and in this context, the Vendor-ID is assigned a value of 5535. This Vendor-ID field also occupies the field 531 of attribute 500. The Vendor-Type field 535 specifies the vendor specific type of attribute and is 8 bits in length. The Vendor-Length field 540 is the length in bytes of the vendor identification fields. An Accounting Stop message with this Session Continue Attribute and the following Accounting Start message must have the same ID value in the Identifier field.

When an Accounting Stop message is received by the RADIUS server 47 at step 450, the Continuation Session Attribute 500 attached thereto will indicate to the RADIUS server 47 that the Accounting Stop message is not the end of the communication session, but the Accounting Stop message will be followed by an Accounting Start message that will continue the communication session. This attribute 500 will instruct the RADIUS server 47 not to deallocate the mobile node's IP address, and as such, the multipart communication session will not be erroneously interrupted by a premature deallocation of the IP address. When the Accounting Start message containing the correlating Identifier is then

received by the RADIUS server 47, the accounting process for the communication session of mobile node 64 will continue without interruption or error.

While the invention has been particularly shown and described with respect to preferred embodiments, it will be readily understood that minor changes in the details of the invention may be made without departing from the spirit of the invention. Having described the invention, we claim:

CLAIMS

1. A communications system, comprising:

a radio network coupled to a serving computer on a first network;

a mobile node coupled to the radio network by a wireless communication link;

a communication server computer linked to the serving computer, said communication server computer controlling the allocation of addresses for the mobile node and performing accounting functions for the first network, and;

a control message transmission on the first network comprising a data element that denotes the continuation of the mobile node's communication session on the first network.

2. The communications system in Claim 1 wherein the control message includes a type field.

3. The communications system in Claim 1 wherein the control message includes a length field.

4. The communications system in Claim 1 wherein the control message includes a vendor-type field.

5. The communications system in Claim 1 wherein the control message includes a field containing the data element.

6. The communications system in Claim 1 wherein the serving computer is coupled to an Internet.

7. The communications system in Claim 1 wherein the serving computer is coupled to a second network.

8. The communication system in Claim 1 wherein the communication server computer will not change the mobile node's address on the foreign network after receiving the control message.

9. The method of continuing a communication session on a communication system comprising the steps of:

transmitting a request message from a serving computer to a first serving computer, said request message contains a session continuation message; and

receiving the request message from said serving computer and maintaining an address allocation for a mobile node on the foreign network.

10. The method of continuing a communication session in Claim 9 wherein the session continuation message is a data element in an accounting message.

11. The method of continuing a communication session in Claim 9 wherein the server computer continues accounting functions for an ongoing communication session in response to the request message.

12. The method of continuing a communication session in Claim 9 wherein the session continuation message includes a type data element.

13. The method of continuing a communication session in Claim 9 wherein the session continuation message includes a length data element.

14. The method of continuing a communication session in Claim 9 wherein the session continuation message includes a vendor-type data element.

15. The method of continuing a communication session in Claim 9 wherein the session continuation message includes an identifier data element.

16. The method of continuing a communication session in Claim 9 wherein the session continuation message includes a session continuation attribute data element.

17. The method of continuing a communication session in Claim 16 wherein the session continuation attribute is a data value in an accounting message.

18. A method for supporting communications on packet-based network comprising the steps of:

receiving a continuation session message, and,

continuing an accounting function a mobile node address on an ongoing communication session after receipt of the continuation session message.

19. The method for supporting communications of Claim 18 wherein the continuation session message includes a type data element.

20. The method for supporting communications of Claim 18 wherein the continuation session message includes a length data element.

21. The method for supporting communications of Claim 18 wherein the continuation session message includes a vendor-type data element.

22. The method for supporting communications of Claim 18 wherein the continuation session message includes an identifier data element.

23. The method for supporting communications of Claim 18 wherein the continuation session message includes a session continuation attribute data element.

CONTINUATION SESSION ATTRIBUTE

ABSTRACT

The present invention supports a new message format and protocol in an IP mobility system. Deallocation of a mobile node's IP address during a multipart communication session on a foreign network can cause serious communication and accounting errors. The new message format and protocol should eliminate the premature deallocation of a mobile node's IP address, which should reduce associated communication and accounting errors.

Attorney's Docket No. P1016 PATENT

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION OR C-I-P)

As a below named inventor, we hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type: (check one applicable item below)

X original

design

supplemental

INVENTORSHIP IDENTIFICATION

My residence, post office address and citizenship are as stated below next to my name. I believe I am the original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

CONTINUATION SESSION ATTRIBUTE

SPECIFICATION IDENTIFICATION

the specification of which: (complete (a), (b) or (c))

(a) X is attached hereto.

(b) was filed on ____ as Serial No. 08/ _____
or Express Mail No., as Serial No. not yet known
and was amended on _____ (if applicable)

(c) was described and claimed in PCT International Application No.
filed on _____ and as amended under PCT Article 19 on _____ (if any).

ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information

X which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56

X and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable examiner would consider it important in deciding whether to allow the application to issue as a patent, and

In compliance with this duty there is attached an information disclosure statement in accordance with 37 CFR 1.98.

PRIORITY CLAIM (35 U.S.C. § 119)

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

(d) X no such applications have been filed.

(e) such applications have been filed as follows.

PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			YES NO
			YES NO

ALL FOREIGN APPLICATIONS(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION

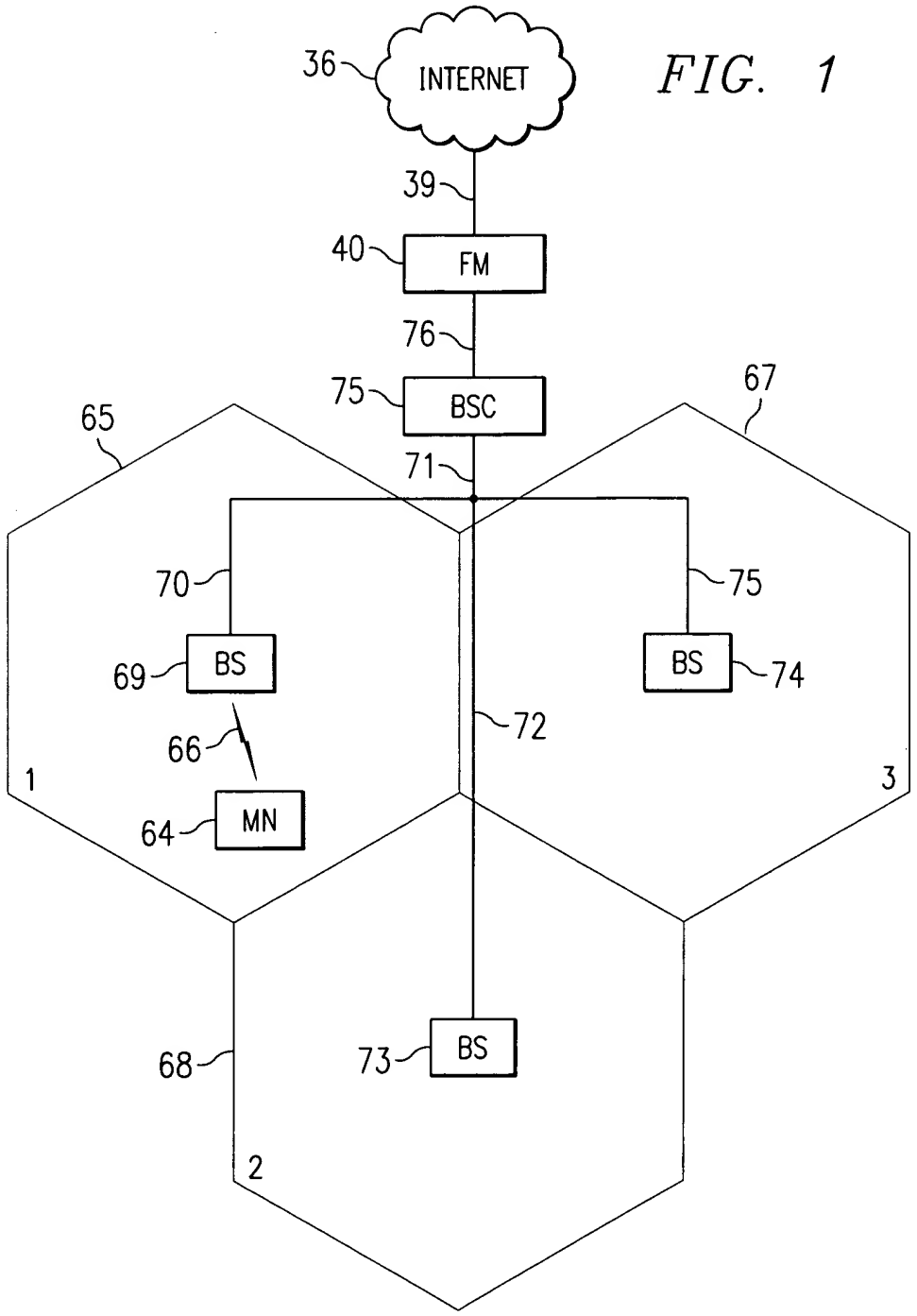
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FIG. 1

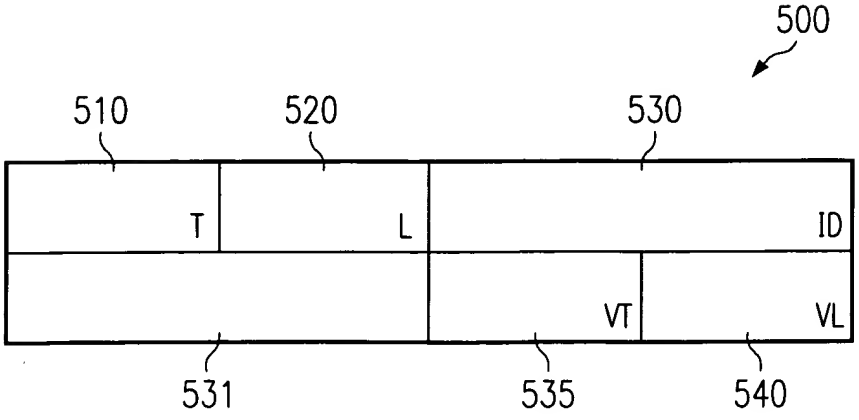
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FIG. 6

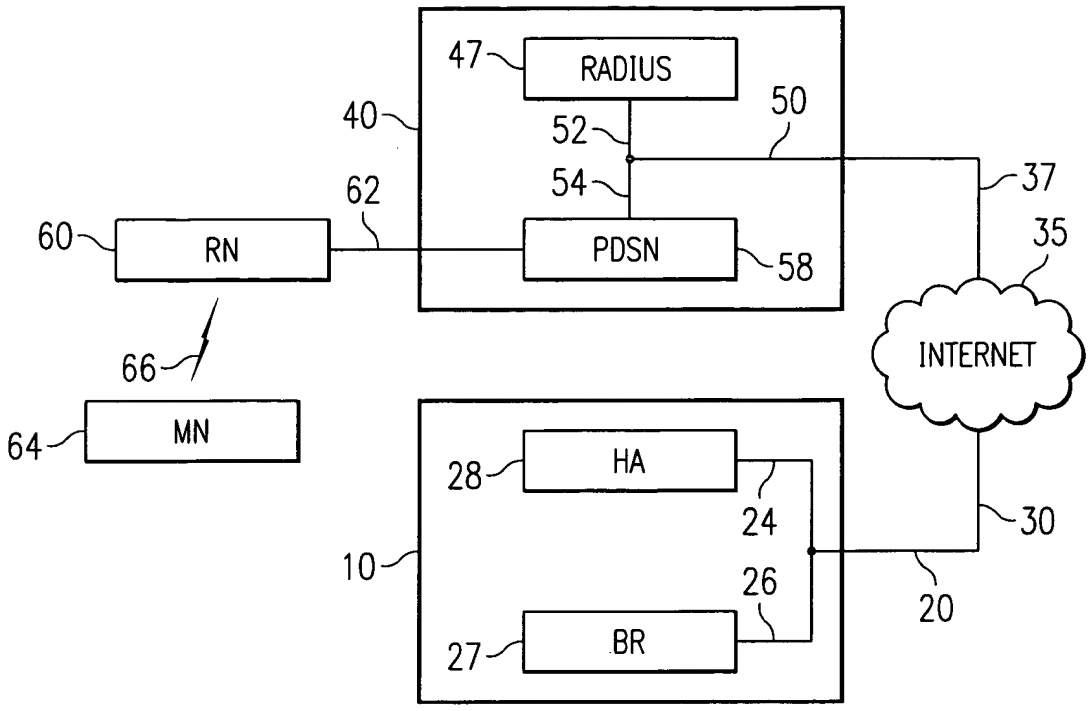

FIG. 2

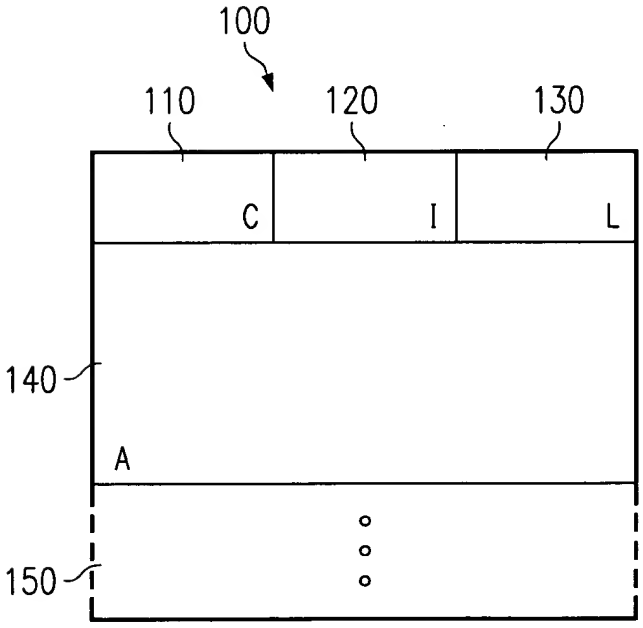

FIG. 3

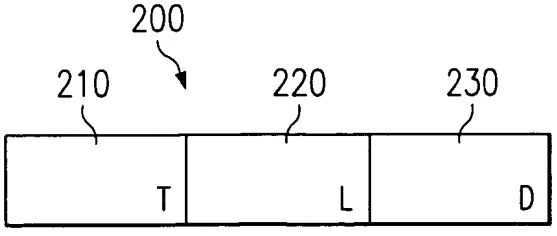

FIG. 4

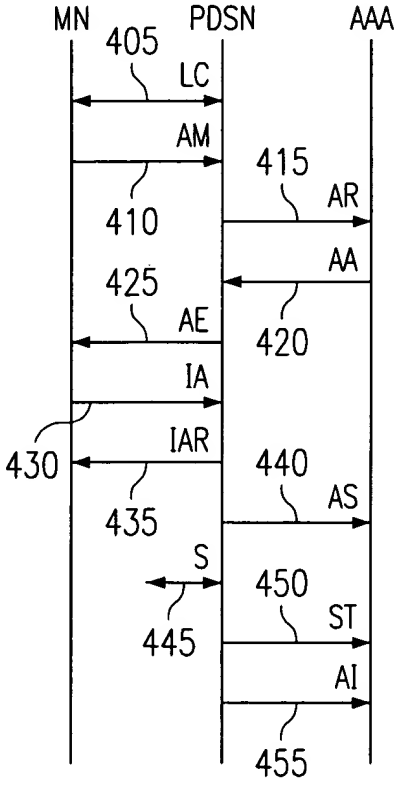

FIG. 5

P1016(12850RRUS02U) PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Peter Wenzel

Serial No.: 09/898,205

Filed: July 3, 2001

For: Continuation Session Attribute

Group Art Unit: 2661

Examiner: Andrew W. Wahba

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO FIRST OFFICE ACTION

In response to the First Office Action mailed March 29, 2005, the Applicant respectfully requests reconsideration in light of the following Response.

CERTIFICATE OF MAILING

I hereby certify that this correspondence is, on the date shown below, being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to the Assistant Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date: June 23, 2005

Amy Kasper

Amy Kasper

INTRODUCTORY COMMENTS

The claims were rejected to as follows:

1. The drawings were objected to because several figure elements lacked descriptive labels. The figures have been amended to add descriptive labels.

2. Claims 1, 7, 8, 9, 10, 11, and 18 are rejected under 35 U.S.C. § 102(e) as being anticipated by United States Patent 6,374,108 to Jakobsen et al (hereinafter "the 108 Patent").

4. Claims 2-5, 12-17, and 19-23 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the '109 Patent in view of United States Patent 5,570,365 to Yoshida.

5. Claim 6 was rejected under 35 U.S.C. § 103(a) as being unpatentable over the '109 Patent in view of United States Patent 6,542,491 to Tari et al.

The Applicant believes the arguments herein traverse the Examiner's rejections and the claims are allowable because the cited prior art does not disclose, teach, or suggest the claimed invention. Accordingly, the Applicant respectfully requests reconsideration and allowance of the claims in light of the following Response.

Applicant is further amending independent Claim 18 to correct a typographical mistake.

AMENDMENTS TO THE DRAWINGS

Figures 1, 2, and 3 lacked descriptive labels on the figure elements. Corrected replacement sheets are being filed herewith.

AMENDMENTS TO THE CLAIMS:

1. (Original) A communications system, comprising:

a radio network coupled to a serving computer on a first network;

a mobile node coupled to the radio network by a wireless communication link;

a communication server computer linked to the serving computer, said communication server computer controlling the allocation of addresses for the mobile node and performing accounting functions for the first network, and;

a control message transmission on the first network comprising a data element that denotes the continuation of the mobile node's communication session on the first network.

2. (Original) The communications system in Claim 1 wherein the control message includes a type field.

3. (Original) The communications system in Claim 1 wherein the control message includes a length field.

4. (Original) The communications system in Claim 1 wherein the control message includes a vendor-type field.

5. (Original) The communications system in Claim 1 wherein the control message includes a field containing the data element.

6. (Original) The communications system in Claim 1 wherein the serving computer is coupled to an Internet.

7. (Original) The communications system in Claim 1 wherein the serving computer is coupled to a second network.

8. (Original) The communication system in Claim 1 wherein the communication server computer will not change the mobile node's address on the foreign network after receiving the control message.

---

9. (Original) The method of continuing a communication session on a communication system comprising the steps of:

transmitting a request message from a serving computer to a first serving computer, said request message contains a session continuation message; and

receiving the request message from said serving computer and maintaining an address allocation for a mobile node on the foreign network.

10. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message is a data element in an accounting message.

---

11. (Original) The method of continuing a communication session in Claim 9 wherein the server computer continues accounting functions for an ongoing communication session in response to the request message.

12. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes a type data element.

13. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes a length data element.

14. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes a vendor-type data element.

15. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes an identifier data element.

16. (Original) The method of continuing a communication session in Claim 9 wherein the session continuation message includes a session continuation attribute data element.

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17. (Original) The method of continuing a communication session in Claim 16 wherein the session continuation attribute is a data value in an accounting message.

18. (Currently Amended) A method for supporting communications on packet-based network comprising the steps of:

receiving a continuation session message, and,

continuing an accounting function for a mobile node address on an ongoing communication session after receipt of the continuation session message.

19. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes a type data element.

20. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes a length data element.

21. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes a vendor-type data element.

22. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes an identifier data element.

23. (Original) The method for supporting communications of Claim 18 wherein the continuation session message includes a session continuation attribute data element.

REMARKS

I. INDEPENDENT CLAIMS 1, 9 AND 18 CLAIM LIMITATIONS NOT FOUND IN THE '109 PATENT

The Examiner rejected independent claims 1, 9 and 18 under 35 U.S.C. § 102(e) in view of the '109 Patent. Applicant respectfully suggests that the '109 Patent does not teach, suggest, or disclose the claimed invention and in fact teaches away from the invention.

The invention is a continuation session attribute that maintains the allocation of the IP address without the server deallocating the IP address and terminating a mobile node's connectivity even though the mobile node has transitioned to a new cell. Claim 1 requires a "control message transmission on the first network comprising a data element that denotes the continuation of the mobile node's communication session on the first network". Claim 9 requires "a request message from a serving computer to a first serving computer, said request message contains a session continuation message; and receiving the request message from said serving computer and maintaining an address allocation for a mobile node on the foreign network". Claim 18 requires "receiving a continuation session message, and continuing an accounting function for a mobile node address on an ongoing communication session after receipt of the continuation session message".

The '109 Patent does not teach, disclose, or suggest a continuation session attribute data element, maintaining allocation of an IP address, or continuing an accounting function for an ongoing communication session. In fact, the '109 expressly teaches away from the existence of such a session continuation attribute because it deallocates the IP address. The '109 Patent discloses a procedure for assigning a

"previously assigned" IP address to a mobile station used on an adjacent cell. In order to be "previously assigned" the mobile station cannot be currently assigned that IP address. In other words, the IP address has been deallocated from the mobile station and may be assigned to another mobile station by the controller. This is clear from the following:

> SwMI 300, acting as a first controller for cell 350 of the first network of the cellular radio communications system, is adapted to receive a request from the mobile station 374 that the cellular radio communication system assign to mobile station 374 the static IP address previously assigned to the mobile station outside of cell 350. If mobile station 374 had passed directly from cell 210 to cell 350, then the request from mobile station 374 to SwMI 300, acting as foreign, agent, would be for the same IP address as mobile station 374 had been using in cell 210.
>
> SwMI 300 is further adapted, in response to the request from mobile station 374, to check with SwMI 200 associated with cell 210 that the static IP address requested has not been assigned to another mobile station. Although in this example mobile station 374 has passed directly from cell 210 to cell 350, in general SwMI 300 is adapted to check with the controller of the cell in the location where the mobile station was previously registered. This may have been another foreign agent for mobile station 374, not shown on FIG. 4.
>
> Finally, SwMI 300 is adapted to assign the static IP address previously assigned to mobile station 374, outside of cell 350, to mobile station 374 for use in cell 350, if the static IP address has not been assigned to another mobile station. Registration with the Home Agent of SWMI 300 allows the forwarding of data packets to the SWMI 300 by tunnelling through the network. It is possible that the IP address previously assigned to mobile station 374, outside of cell 350, has been assigned by SwMI 200 to another mobile station, and is therefore no longer available to be assigned by SwMI 300 for use in cell 350. It is also possible that another mobile station already within cell 350 has been given the IP address previously used by mobile station 374, and that for this reason the IP address previously assigned to mobile station 374 is no longer available for assignment by SwMI 300 to mobile station 374 for use in cell 350.
> *The '109 Patent, col. 6, ln. 4-39 (emphasis added).*

Thus, the '109 Patent does not maintain allocation of the IP address or continuation of the mobile node's accounting when it transitions to a new cell. Rather, the '109 Patent discloses a procedure where a mobile node is allocated a previously used IP address, but

that previously used IP address has been deallocated and now must be allocated again to the mobile station. In the interim, before the controller assigns the "previously assigned" IP address back to the mobile station, the controller can assign that IP address to a different mobile station.

In the invention, the connectivity and the IP address allocation are maintained. The IP address cannot be assigned to another mobile node, because the controller never deallocates the address to free it for assignment to another mobile node. There is not an allocation of a "previously assigned" IP address as taught in the '109 Patent because the invention does not deallocate the IP address (e.g. does not assign a previously used IP address).

Furthermore, as shown above, the '109 Patent exhibits the problem the invention eliminates. As stated in the specification of the application, under the prior art, a server can deallocate a mobile node address and erroneously assign that IP address to another mobile node, and the invention solves this problem. *See Application, p. 13, ln 19-25 – p. 14, ln. 1-3*. This prior art problem is clearly a characteristic of the '109 Patent as, stated above, where the previously used IP address can be allocated to another mobile station. Because deallocation of the mobile node's address occurs in the '109 Patent as described for prior art systems in the application's specification, the '109 Patent covers a prior art system cannot disclose, suggest, or teach a session continuation attribute or its method of operation.

Independent Claims 1, 9, and 18 are allowable because the '109 Patent does not teach, suggest, or disclose the claimed limitations. Since the dependent claims add further limitations to the limitations of the allowable independent claims, the Applicant

believes the dependent claims are likewise allowable and that the amended independent claims render the § 103(a) rejections of the independent claims as moot.

II. CONCLUSION

The Applicant respectfully requests reconsideration of the present application because the Examiner's 35 U.S.C. § 103(a) and § 102(e) rejections are believed to have been traversed by the present Response. Pending claims 1-23 are believed allowable because the claimed invention is not disclosed, taught, or suggested by the cited references.

It is believed that no additional fees are necessary for this filing. If additional fees are required for filing this response, then the appropriate fees should be deducted from D. Scott Hemingway's Deposit Account No. 501,270.

Respectfully submitted,

Malcolm W. Pipes

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Reg. No. 46,995
Attorney for Applicant

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(214) 739-5209 (fax)

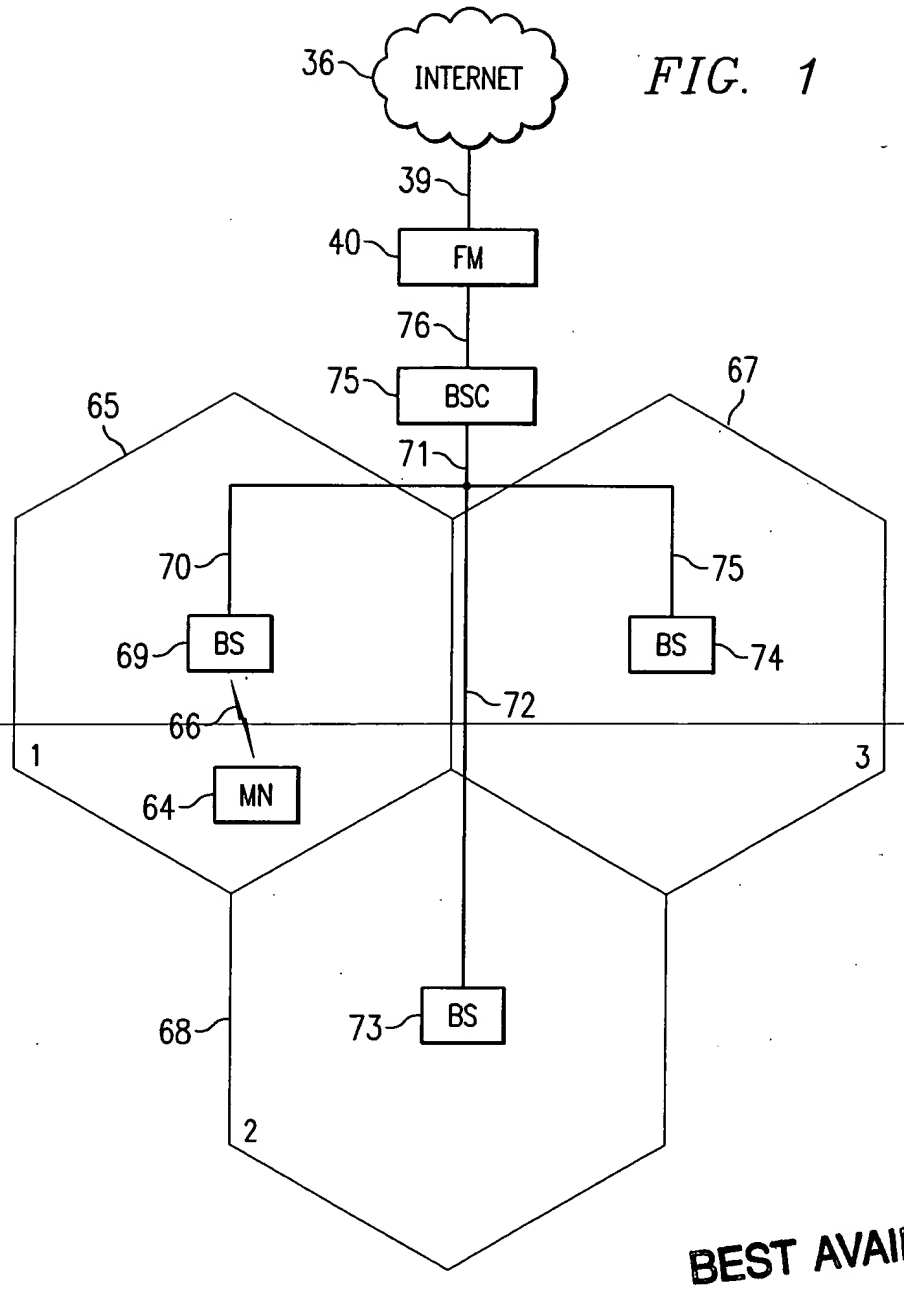

FIG. 1

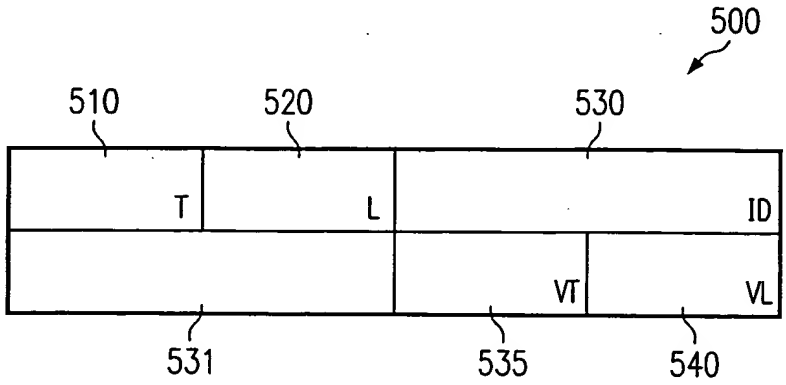

FIG. 6

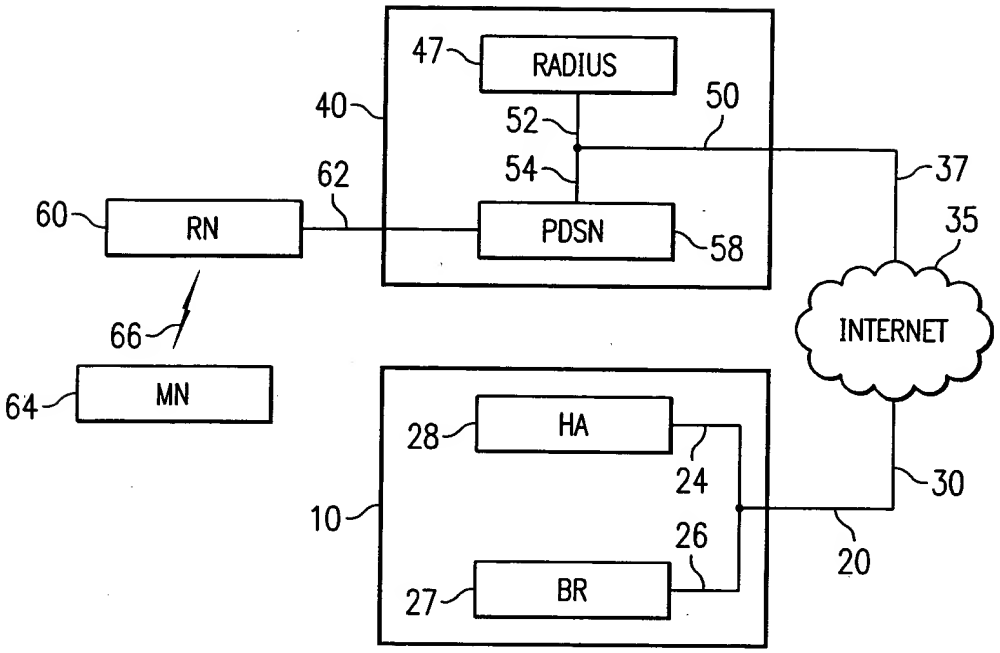

FIG. 2

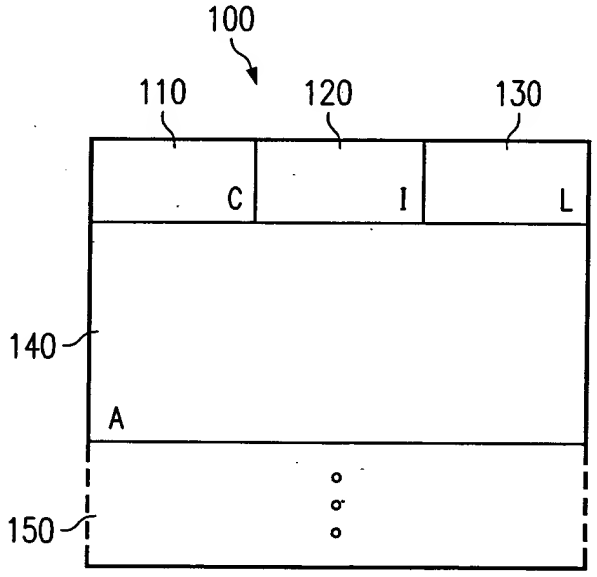

FIG. 3

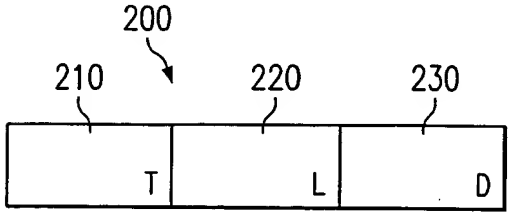

FIG. 4

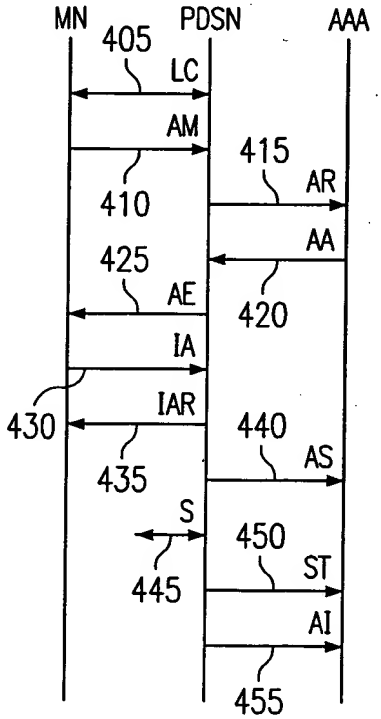

FIG. 5

NNI 02621 PTUS / P1016

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/898,205	07/03/2001	Peter W. Wenzel	P1016 (12850RRUS02U)	2218

7590 09/20/2005

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8117 PRESTON RD.
PRESTON COMMONS WEST, SUITE 460
DALLAS, TX 75225

RECEIVED
SEP 2[illegible] 2005

EXAMINER	
MOORE, IAN N	

ART UNIT	PAPER NUMBER
2661	

DATE MAILED: 09/20/2005

Final OA due 12/20/05
New drawings also

Please find below and/or attached an Office communication concerning this application or proceeding.

EXHIBIT
tabbies
4

Docketed by QD 9/27/05

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/898,205	WENZEL ET AL.	
	Examiner	Art Unit	
	Ian N. Moore	2661	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *27 June 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-23* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-23* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 June 2005* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings were received on 6/27/05. These drawings FIG. 1 and 2 are accepted by the examiner.

2. The drawings (**FIG. 3-6**) are objected to because there is no direct correlation between labels in the specification. Another word, if the labels were, then the full description of the acronym, which directly correlated with acronym/label used in the drawing, should be clearly defined in the speciation. For example, in FIG. 5, the specific direct correlation of label "LC" or "AM" is not described anywhere in the specification, although it appears to describe numerical label step. Any structural detail that is essential for a proper understanding of the disclosed invention should be shown in the drawing. MPEP § 608.02(d). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application.

Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not

accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action.

The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

4. Claims 1,7-11, and 18 are rejected under 35 U.S.C. 102(e) as being anticipated by Jakobsen (US006374108B1).

With regard to claim 1, Jakobsen discloses a radio communication system (radio network) that includes a base station 358 (serving computer) in cell 350 (first network) as illustrated in Figure 4 (see col. 4, line 22-26). Jakobsen discloses a mobile station 374 (mobile node I wireless communication link) that originates from cell 210 in which SWMI 200 acts as a home agent (column 5, lines 41-45). SWMI 300 (communication server computer), acting as a foreign agent: in cell 350, receives a request from mobile station 374 that the cellular radio communication system assign to the mobile station the same static IP address (controlling the allocation of addresses/ performing accounting functions) as previously outside of cell 350 (column 6, lines 4-10). SWMI 300 checks (control message transmission) with SWMI 200

whether the static IP requested by mobile station 374 has been assigned to another station (continuation of mobile node's communication session) (column 6, lines 14-18).

With regard to claim 7, Jakobsen discloses SWMI 300 in cell 350 is linked via connection 280 (coupled) to SWMI 200 in cell 210 as illustrated by Figure 4 (column 5, lines 66-67).

With regard to claim 8, SWMI 300 (communication server computer), acting as a foreign agent in cell 350, receives a request from mobile station 374 that the cellular radio communication system assign to the mobile station the static IP address previously outside of cell 350 (will not chance mobile node's address) (column 6, lines 4-10).

With regard to claim 9, Jakobsen discloses a mobile station 374 that originates from cell 210 where SWMI 200 (first serving computer) acts as a home agent (column 5, lines 41-45). SWMI 300 (serving computer), acting as a foreign agent, receives a request from mobile station 374 that the cellular radio communication system assign to the mobile station the same static IP address as previously outside of cell 350(maintaining an address allocation) (column 6, lines 4-10). SWMI 300 checks with SWMI 200 (transmitting a request message / receiving the request message) whether the static IP requested by mobile station 374 has been assigned to another station (session continuation) (column 6, lines 14-18).

With regard to claims 10 and 11, SWMI 300 checks (continuation message / accounting message) with SWMI 200 whether the static IP requested by mobile station 374 has been assigned to another station (accounting functions) (column 6, lines 1418).

With regard to claim 18, Jakobsen discloses a mobile station 374 that originates from cell 210 where SWMI 200 acts as a home agent (column 5, lines 41-45). SWMI 300, acting as a

foreign agent, receives a request from mobile station 374 that the cellular radio communication system assign to the mobile station the same static IP address as previously outside of cell 350 (column 6, lines 4-10). SWMI 300 checks with SWMI 200 (receiving a continuation session message) whether the static IP requested by mobile station 374 has been assigned to another station (continuing accounting function mobile node address) (column 6, lines 14-18).

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 2-5, 12-17, and 19-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jakobsen et al, hereinafter "Jakobsen" (US Patent 6,374,108) in view of Yoshida (US Patent 5,570,365).

With regard to claims 2, 12, and 19, Jacobsen does not expressly disclose a type field or type data element.

Yoshida discloses a typical format of packets used in a local area network in which the IP header includes a type-of-service (type field / type data element) (column 3, lines 37-40).

A person of ordinary skill in the art would have been motivated to employ Yoshida in Jakobsen so as to communicate control information contained in the packet header. At the time the invention was made, therefore, it would have been obvious to one of ordinary skill in the art to which the invention pertains to obtain the invention as specified in claims 2, 12 and 19.

With regard to claims 3, 13 and 20, Yoshida discloses a total-length field (length field / length data element) (column 3, lines 37-40).

With regard to claims 4, 14 and 21, Yoshida discloses a version field (vendertype field / vender-type data element) (column 3, lines 37-40).

With regard to claims 5, 15 and 22, Yoshida discloses an identification field (data element / identifier data element) (column 3, lines 37-40).

With regard to claims 16, 17 and 23, SWMI 300 checks (session continuation attribute/accounting message) with SWMI 200 whether the static IP requested by mobile station 374 has been assigned to another station (see col. 6, line 14-18).

7. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jakobsen et al, hereinafter "Jakobsen"' (US Patent 6,374,108) in view of Tari et al, hereinafter "Tari" (US Patent 6,552,491).

Jakobsen does not expressly disclose that the serving computer is coupled to an Internet. Tari discloses a terminal unit 5-1 connected to network 2 (Internet) via wireless server B 3-2 (serving computer) as illustrated by Figure 1 (column 3, lines 38-52).

A person of ordinary skill in the art would have been motivated to employ Tari in Jakobsen so as to communicate packet data such as e-mail to a wireless terminal. At the time the invention was made, therefore, it would have been obvious to one of ordinary skill in the art to which the invention pertains to obtain the invention as specified in claim 6.

Response to Arguments

8. Applicant's arguments filed 6/27/05 have been fully considered but they are not persuasive.

Regarding claims 1,9, and 18, the applicant argued that, "...109 patent does not teach, disclose, or suggest a continuation session attribute data element, maintaining allocation of an IP address or continuing an accounting function for an ongoing communication session...109 expressly teaches away from the existence of such a session continuation attribute because it deallocates the IP address...." in page 1, paragraph 3; page 2, paragraph 2; page 3, paragraph 1, 4.

In response to applicant's argument, the examiner respectfully disagrees with the argument above. Jakobsen teaches a continuation session attribute data element, maintaining allocation of an IP address or continuing an accounting function for an ongoing communication session. In particular, as described in above previous and above rejection, Jakobsen discloses a mobile station 374 (mobile node I wireless communication link) that originates from cell 210 in which SWMI 200 acts as a home agent (column 5, lines 41-45). SWMI 300 (communication server computer), acting as a foreign agent: in cell 350, receives a request from mobile station 374 that the cellular radio communication system assign to the mobile station the same static IP address (controlling the allocation of addresses (performing accounting functions) as previously outside of cell 350 (column 6, lines 4-10). SWMI 300 checks (control message transmission) with SWMI 200 whether the **static** IP requested by mobile station 374 has been assigned to another station (continuation of mobile node's communication session) (column 6, lines 14-18).

In summary, Jakobsen discloses assigning/allocating "**static**" or "**same**" IP address which is **previously** used is assigned in the new cell, thereby, continuing the service, and the packets can be forward to the mobile by means of tunneling; see col. 6, line 5-14, 25-30, which is analogous to applicant claimed invention of "a continuation session attribute data element, maintaining allocation of an IP address or continuing an accounting function for an ongoing communication session". One skill in the ordinary art would clearly see that when "mobile station" in the new cell is assigned with the "same", "static", or "previous" IP address from the old cell, it is a "continuation of the mobile's communication session" since the same/static/previous address is continued to use. Jakobsen even teaches such scenario as "tunneling" or "static".

Jakobsen's scenario of assigning static IP address is clearly disclosed the applicant claimed limitation, although there may be other scenario. Jakobsen describing various scenario of assigning IP address does not make Jakobsen teach away from the invention since **one** of the scenarios is clearly anticipated the applicant claimed invention.

The applicant argued that, "...in the invention, the connectively and the IP address are maintained...The IP address cannot be assigned to another mobile node, because the controller server never deallocates the address to free it for assignment to another mobile node ..." in page 3, paragraph 2.

In response to applicant's argument that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., **The IP address cannot be assigned to another mobile node, because the controller server never deallocates the address to free it for assignment to another mobile node**) are not recited in

the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993).

Moreover, identical to the applicant claimed invention, Jakobsen also maintains the connectively and IP address by means of static IP address and tunneling, as described in above response.

In view of the above, **the examiner respectfully disagrees** with applicant's argument and believes that the Jakobsen as set forth in the 102 rejection is proper.

Conclusion

9. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ian N. Moore whose telephone number is 571-272-3085. The examiner can normally be reached on 9:00 AM- 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chau Nguyen can be reached on 571-272-3126. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

INM
9/16/05

CHAU NGUYEN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

US006374108B1

(12) **United States Patent**
Jakobsen et al.

(10) **Patent No.: US 6,374,108 B1**
(45) **Date of Patent: Apr. 16, 2002**

(54) **ASSIGNING AN IP ADDRESS TO A MOBILE STATION WHILE ROAMING**

(75) Inventors: **Ken Jakobsen**, Vaerloese (DK); **Rod Averbuch**, Buffalo Grove, IL (US); **John Hughes**, Basingstoke (GB); **Kenneth James Crisler**, Lake Zurich; **Guy George Romano**, Elmhurst, both of IL (US)

(73) Assignee: **Motorola, Inc.**, Schaumburg, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/451,328**

(22) Filed: **Nov. 30, 1999**

(51) **Int. Cl.**[7] **H04Q 7/20**
(52) **U.S. Cl.** **455/432**; 455/435; 455/552; 370/338; 370/401
(58) **Field of Search** 455/414, 432, 455/433, 435, 445, 466, 552, 553, 556, 557, 422; 370/331, 338, 389, 400, 401, 402, 252; 702/23; 709/226, 239; 713/201, 202

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,159,592 A	*	10/1992	Perkins	370/401
5,572,528 A	*	11/1996	Shuen	370/402
5,812,819 A	*	9/1998	Rodwin et al	713/201
6,147,986 A	*	11/2000	Orsic	370/331
6,195,705 B1	*	2/2001	Leung	455/426
6,230,012 B1	*	5/2001	Willkie et al.	455/435

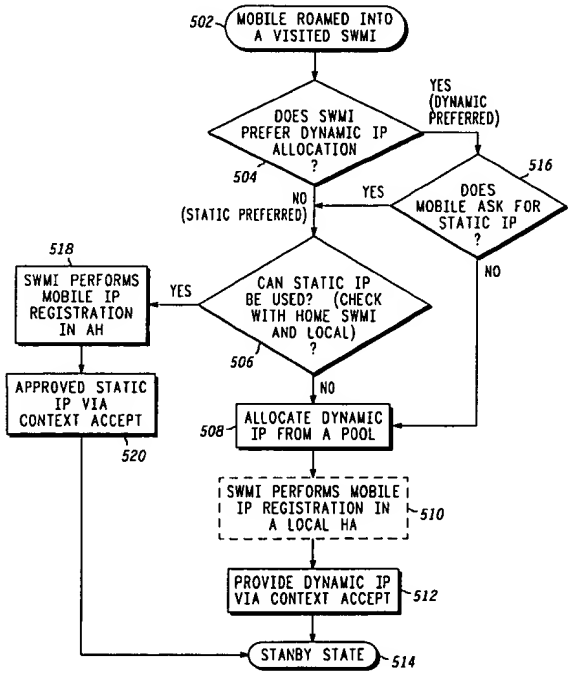
* cited by examiner

Primary Examiner—Lester G. Kincaid
(74) *Attorney, Agent, or Firm*—Colin Treleven; Steven R. Santema

(57) **ABSTRACT**

A cellular radio communications system comprises: at least one base station for broadcasting radio signals to mobile stations within a cell; a mobile station addressable using IP addresses; and a first controller in the cell of the cellular radio communications system, the first controller being adapted: (i) to receive a request from the mobile station that the cellular radio communication system assign to the mobile station the static IP address previously assigned to the mobile station outside of the cell; (ii) in response to the request from the mobile station, to check with a second controller associated with the location where the mobile station was previously registered that the static IP address has not been assigned to another mobile station; and (iii) to assign the static IP address previously assigned to the mobile station, outside of the cell, to the mobile station for use in the cell, if the static IP address has not been assigned to another mobile station. Alternatively, the first controller may perform the check for availability of the static IP address with a controller associated with the location where the static IP address is registered. The invention also comprises methods of mobile station registration in cellular radio communication systems. The invention enables roaming by a mobile station between cellular systems which are under the control of different Software and Measurement Infrastructures. Mobile stations may be adapted to check one or more timers prior to making the static IP address request.

23 Claims, 5 Drawing Sheets



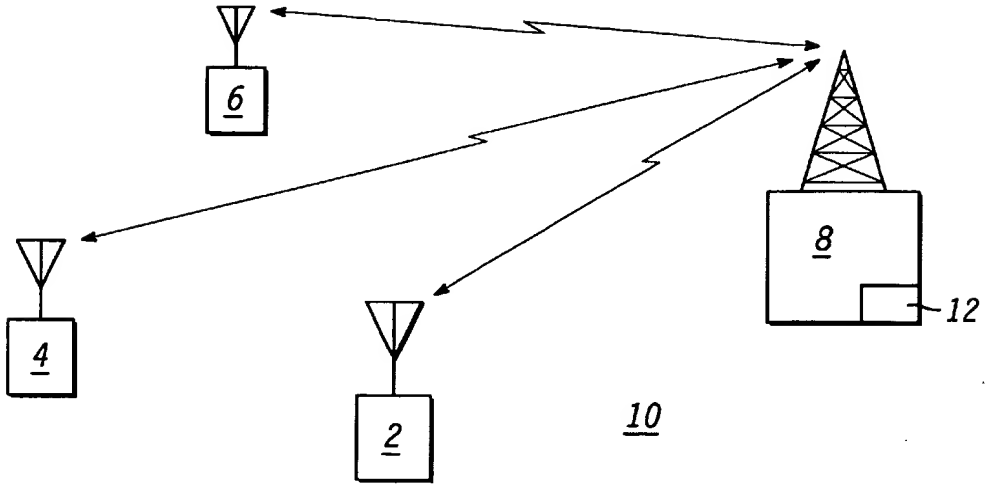
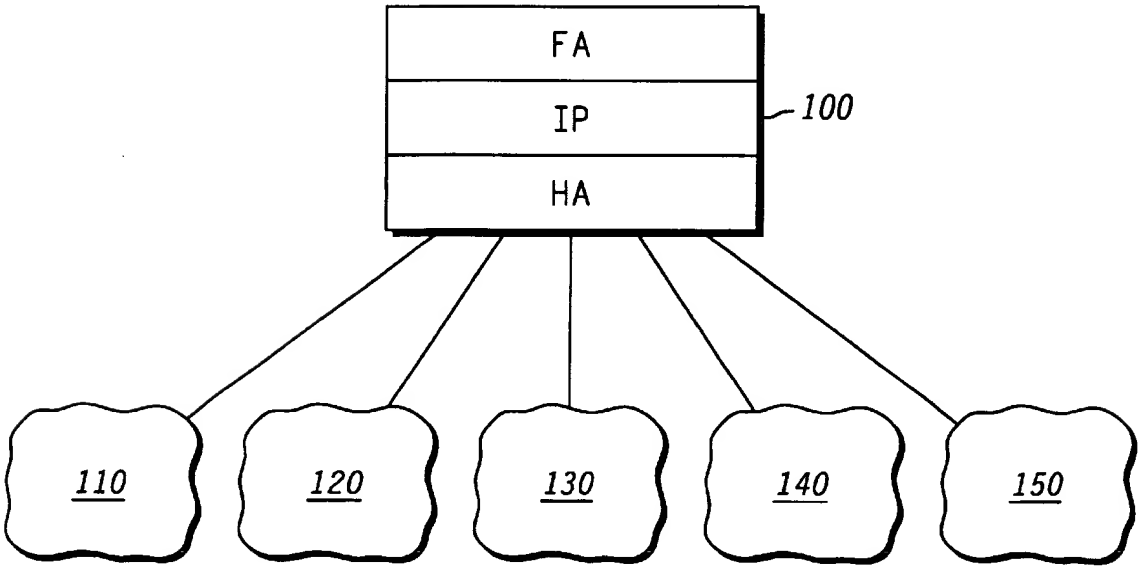


FIG. 1

FIG. 2



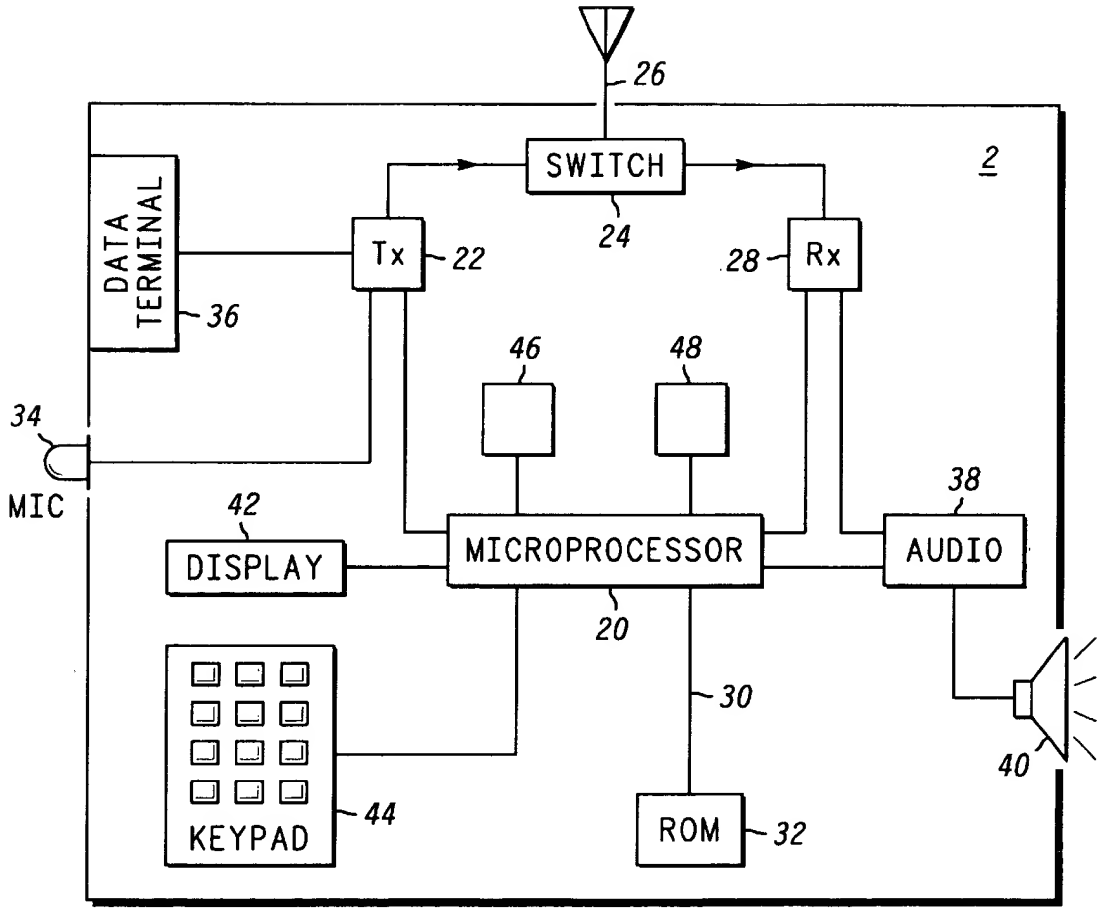

26
SWITCH
24
2
DATA TERMINAL
36
Tx
22
28
Rx
46
48
34
MIC
38
42
DISPLAY
MICROPROCESSOR
AUDIO
20
30
40
KEYPAD
44
ROM
32

FIG. 3

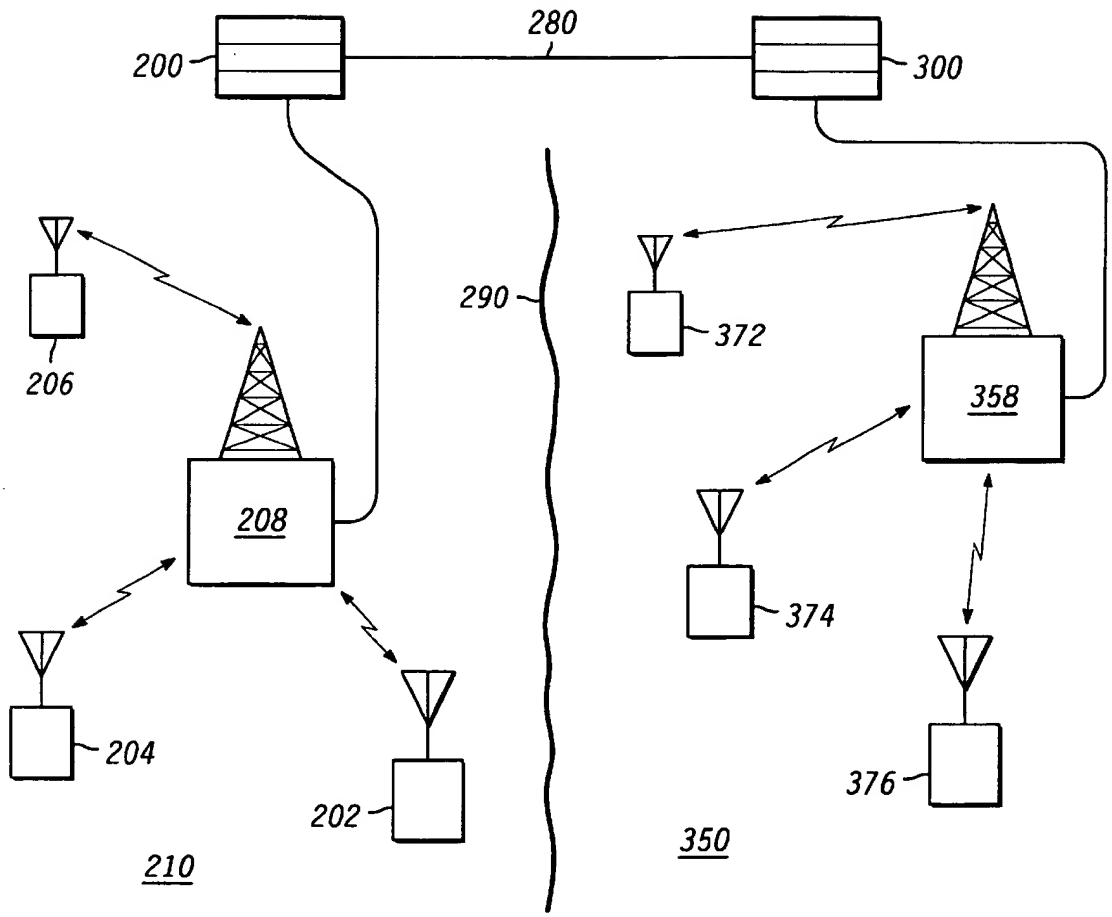


FIG. 4

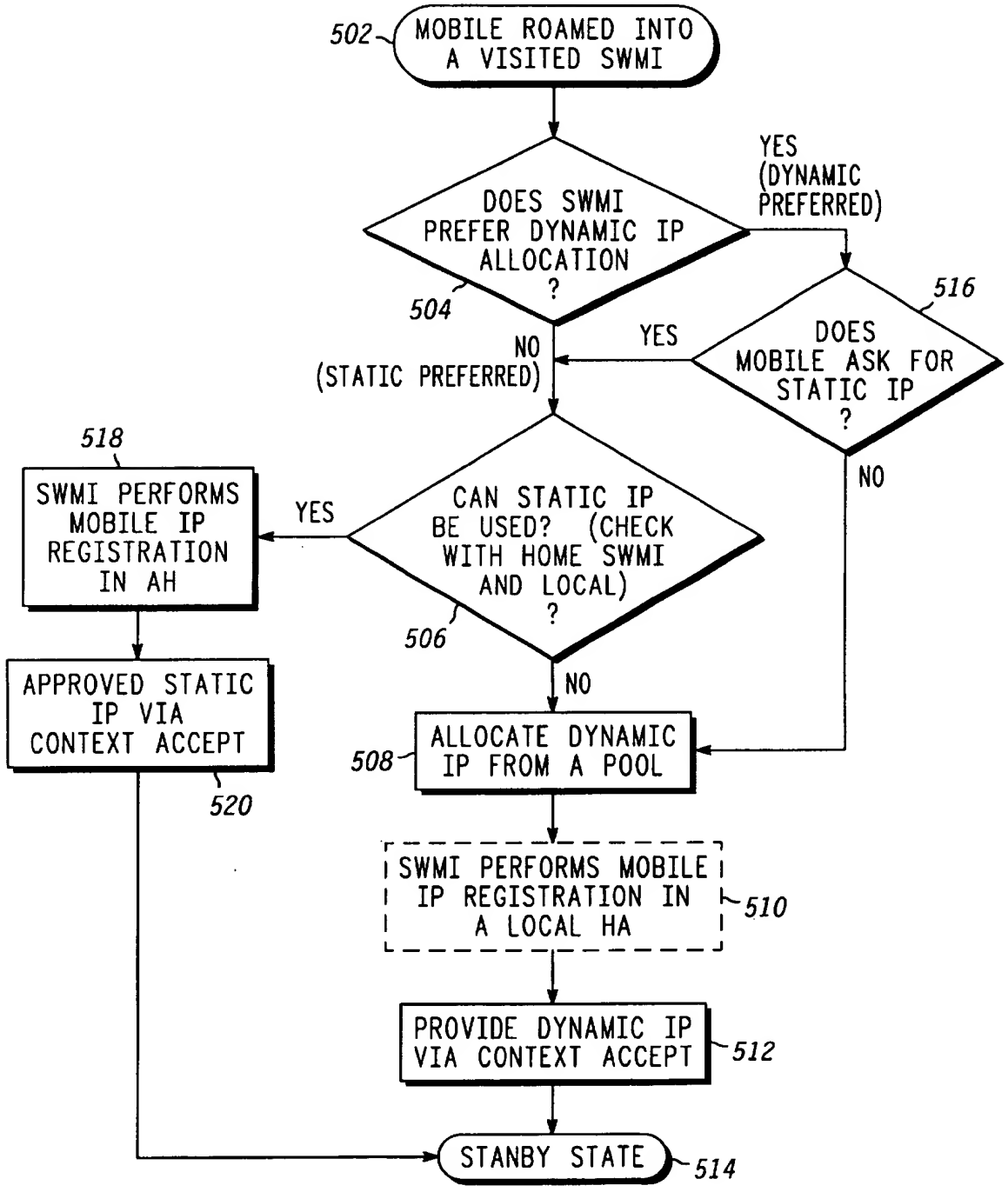

502
MOBILE ROAMED INTO A VISITED SWMI
DOES SWMI PREFER DYNAMIC IP ALLOCATION ?
504
YES (DYNAMIC PREFERRED)
516
DOES MOBILE ASK FOR STATIC IP ?
YES
NO (STATIC PREFERRED)
NO
518
SWMI PERFORMS MOBILE IP REGISTRATION IN AH
YES
CAN STATIC IP BE USED? (CHECK WITH HOME SWMI AND LOCAL) ?
506
NO
APPROVED STATIC IP VIA CONTEXT ACCEPT
520
508
ALLOCATE DYNAMIC IP FROM A POOL
SWMI PERFORMS MOBILE IP REGISTRATION IN A LOCAL HA
510
PROVIDE DYNAMIC IP VIA CONTEXT ACCEPT
512
STANBY STATE
514

FIG. 5

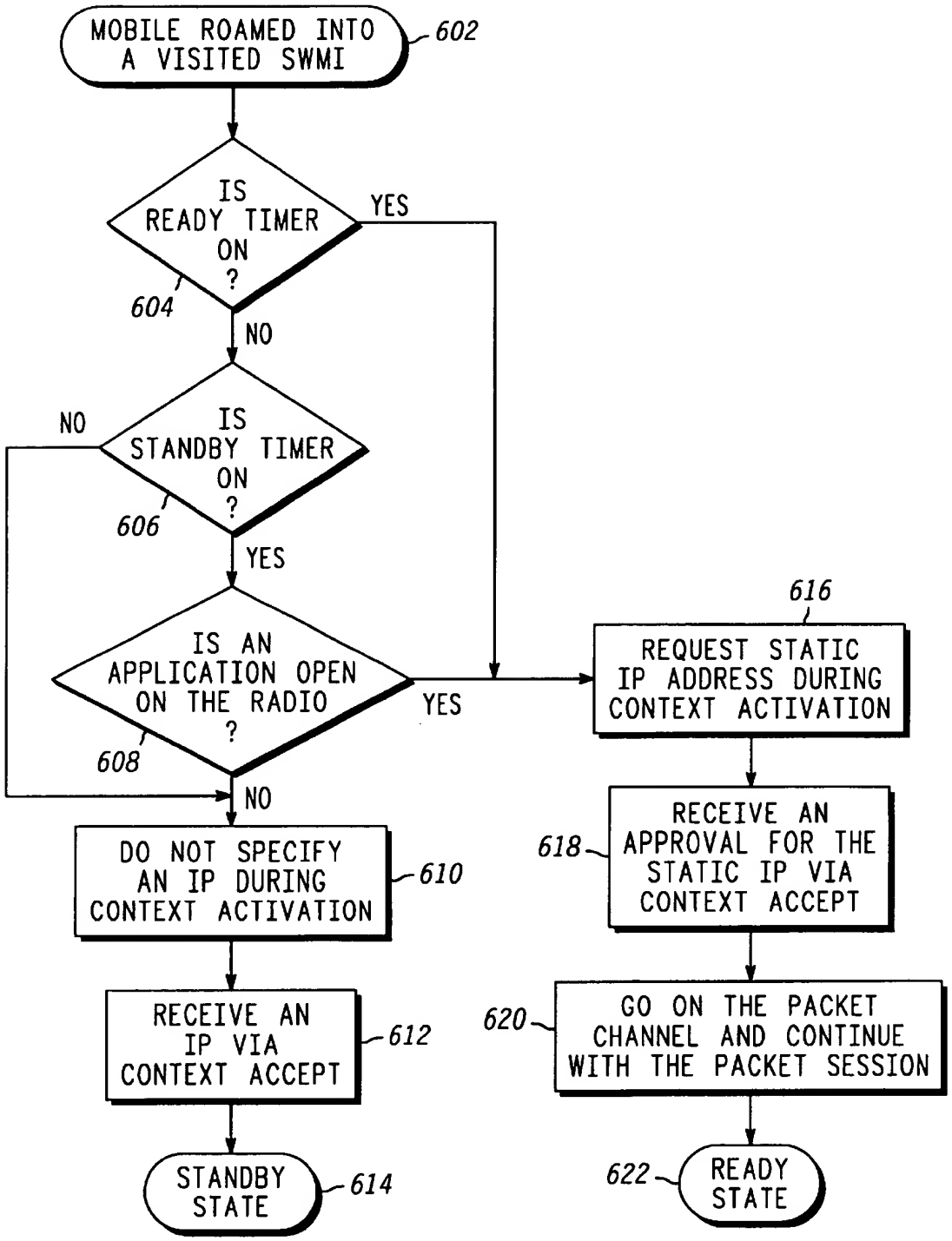

MOBILE ROAMED INTO A VISITED SWMI
602
IS READY TIMER ON ?
604
YES
NO
IS STANDBY TIMER ON ?
606
NO
YES
IS AN APPLICATION OPEN ON THE RADIO ?
608
YES
NO
DO NOT SPECIFY AN IP DURING CONTEXT ACTIVATION
610
RECEIVE AN IP VIA CONTEXT ACCEPT
612
STANDBY STATE
614
616
REQUEST STATIC IP ADDRESS DURING CONTEXT ACTIVATION
618
RECEIVE AN APPROVAL FOR THE STATIC IP VIA CONTEXT ACCEPT
620
GO ON THE PACKET CHANNEL AND CONTINUE WITH THE PACKET SESSION
622
READY STATE

FIG. 6

ASSIGNING AN IP ADDRESS TO A MOBILE STATION WHILE ROAMING

TECHNICAL FIELD

The present invention relates to the field of mobile radio communication systems.

BACKGROUND

Prior art mobile radio communication systems may be divided up into cells. Mobile telephones or mobile radios, henceforth referred to as mobile stations, can move within a cell. Mobile stations can also move from one cell to another.

FIG. **1** illustrates a single cell of a cellular radio system. The elements shown in FIG. **1** show the general scheme of a personal mobile radio (PMR) system **10**. Portable radios **2**, **4** and **6** of FIG. **1** can communicate with a base station **8**. Radios **2**, **4** and **6** could equally well be mobile radios mounted in vehicles. Each of the radios shown in FIG. **1** can communicate through base station **8** with one or more other radios. If radios **2**, **4** and **6** are capable of direct mode operation, then they may communicate directly with one another or with other radios, without the communication link passing through base station **8**. Radios **2**, **4** and **6** constitute mobile stations in this system.

Examples of prior art radio systems of the general type illustrated in FIG. **1** are the iDEN and TETRA radio systems.

FIG. **2** shows the arrangement of several cells **110**, **120**, **130**, **140**, **150** of a cellular radio system. A 'Software and Measurement Infrastructure' (SwMI) **100** controls these five cells. The SwMI and the cells which the SwMI controls together constitute a radio 'network'. The SwMI is responsible for a variety of functions. These typically include control of the assignment of IP addresses to mobile stations operating in the network, and the routing of communications to and amongst mobile agents in the network. A radio such as those shown as **2**, **4** or **6** in FIG. **1** can move from cell to cell within the network, communicating in any of the cells.

The SwMI **100** shown in FIG. **2** performs several functions, indicated as 'FA', 'IP' and 'HA' in block **100**. The 'IP' box indicates that the SwMI is responsible for allocating IP addresses (numbers) to radios operating within the cells **110–150**. The IP address allows packets of data with the correct IP address to be delivered to the radio within the network. The SwMI will keep a table showing the cell within which a mobile radio is located, in order to be able to route calls to a base station located within communication range of the mobile station.

The 'HA' block in element **100** indicates that the SwMI also performs 'Home Agent' (HA) functions for radios which normally operate in the network. Finally, the 'FA' block in element **100** indicates that the SwMI also performs 'Foreign Agent' (FA) functions for radios which enter the network, but which normally do not operate in that network. The Home Agent and Foreign Agent functions will be explained in greater detail below and in connection with FIG. **4**.

Mobile stations may be capable of operating in a number of different networks, for example those in different countries. This is referred to as 'roaming'. Already, a radio designed according to the TETRA standard may roam from one network to another. Within the GSM and PCS **1800** digital mobile telephone standards, mobile telephones may roam between networks and/or countries.

In future, it will be desirable for mobile stations to be reachable easily through Internet Protocol (IP) addressing. It would be particularly desirable for IP addressable mobile stations to be able to roam from one network to another network.

Several schemes have been proposed to allow IP addressable mobile stations to roam within a cellular radio communications network, or between such networks.

Four examples of these schemes are explained below.

Mobile Internet Protocol

A fully mobile internet protocol system has been proposed. In this system, the mobile stations are capable of recognising when they are in a 'foreign' cell which is not part of the network within which they normally operate. The network within which they normally operate is the network in which they are under the control of their 'Home Agent'. The home agent is provisioned with IP addresses for the mobile stations within the network within which the mobile station normally operates. A cell not under control of the home agent is referred to as being under the control of a 'Foreign Agent'.

When a mobile station has moved from its home network to another, foreign network, data packets with IP addresses can still reach the mobile station. The mobile internet protocol allows the home agent to map and encapsulate the IP addresses of mobile stations into a 'care of' address of the foreign agent, for forwarding to the foreign agent.

According to the mobile internet protocol proposal, the mobile stations will be able to transmit information to their Home Agent about the Foreign Agent where they are currently situated. This requires the mobile station to be adapted to recognise that it is not in a cell which is under the control of the Home Agent, and also to recognise the identity of the Foreign Agent, and to provide that information to its Home Agent as part of performing registration with the Home Agent.

iDEN Mobile IP radio

The IDEN Mobile IP radio has a mode where it can perform a mobile IP role as a proxy for non-mobile Data Terminal Equipment (DTE) attached to it. An example of such a DTE might be a lap-top portable computer. In this case, the iDEN radio must be arranged to perform the proxy function, and must itself be mobile IP capable in the sense described above.

Cellular Digital Packet Data Mobility

Cellular Digital Packet Data (CDPD) is a wireless data system used in the USA. In this system, IP addressing whilst roaming is possible only if both the infrastructure and the mobile station are adapted for the mobility function.

Thus in CDPD, IP address roaming is only possible for those handsets which have been adapted appropriately, and for these handsets, only within cells which can support roaming.

TETRA Packet Data Standard

The TETRA packet data standard EPT WG3(98) 005 describes the means for the SwMI to allocate an IP address to a Mobile radio. The IP allocation procedure is part of TETRA 'context activation'. A mobile station performs context activation. Context activation is the act of a mobile station registering with a network to start sending and receiving packet data using IP addressing over the network. The network assigns an IP address to the mobile station at the time of context activation. Thus context activation allows the mobile station to gain an internet connection to send and receive 'IP packets'.

A TETRA radio does not need to perform context activation in order to simply conduct voice communication over a radio network. However, when the radio needs to send packet data over the TETRA network, then the radio must

perform context activation. The TETRA radio may be commanded to perform context activation by the user. Alternatively, the radio may realise that it needs to perform context activation due to an outside stimulus, such as when the radio has been connected to a PC, and the PC boots up.

When context activation is complete, the network can map the IP address assigned to a radio to that radio's Individual TETRA Subscriber Identity (ITSI). When the network receives a packet of data for the radio, then the network can locate the radio using the location map which it holds of the radios' ITSI numbers. This then allows the network to forward the data packet to the radio's location within the network.

The IP address allocated to a mobile station in a network can be either 'static' or 'dynamic'. A 'static' IP address is normally an address which the mobile radio asks to use when it performs context activation. This will be the IP address which the mobile radio has used previously.

However, a radio may not specify any particular IP address at context activation. If this is the case, then there are two possible outcomes. Firstly, the network may recognise the mobile station, and allocate to the mobile station the same IP address as the network has previously assigned to that mobile station. This is static addressing, but without the mobile station having specified any IP address it its context activation request. The second possible outcome is that the network assigns any IP address to the mobile which is currently not in use, from the pool of IP addresses available to that network. This is 'dynamic' address allocation. The SwMI holds a pool of IP addresses for use in dynamic allocation. The pool of addresses available to one SWMI may differ from the pool available to another SWMI, for example that of a network in a different country, or that of a network owned by a different company.

The TETRA packet data standard allows the mobile radio to request a specific IP address to be approved by the SWMI. However, the current standard does not provide the means of roaming between different SWMIs.

Looking at the TETRA packet data standard in further detail, this standard defines 3 basic states of the Mobile radio. These are:

(i) Idle—This is the state prior to context activation.

(ii) Standby—This is the state after context activation.

(iii) Ready—This is the state during data activity.

The mobile station has two timers. One of these is the 'standby' timer. The standby timer measures the time since context activation. Typically the timer may be set to several hours from context activation before it 'times out', and the mobile station returns to idle mode. When the stand-by timer has expired, a mobile radio needs to perform context activation in order to once more commence data exchange over the network.

The other timer is the 'ready' timer. The mobile radio is in a ready state while it is in active operation, exchanging data packets over the network. The time limit of the ready timer is designed such that, when the ready timer has not yet timed out, the mobile station is likely to still be in an ongoing communication over the network. The ready timer times for typically 10 seconds after the most recent packet data activity. So the state of the ready timer specifies the state of the mobile radio, i.e. whether or not it is currently communicating. When the ready timer times out, the radio returns to the stand-by mode. Expiry of the ready timer does not cause the mobile radio to need to perform context activation in order to commence IP packet data transmission or reception.

In its home network, the mobile radio will keep one IP address until the stand-by timer times out. This means that the mobile will keep one IP address for a fairly long period after it has last sent or received a data packet using that IP address. This period might typically be 24 hours, during which the mobile radio is in stand-by mode. As long as less than this time has elapsed, the mobile radio does not need to perform context activation in order to commence IP data packet transmission or reception. If the mobile re-commences IP data packet transmission or reception when in stand-by mode, the mobile will re-set both the stand-by and ready timers.

However, a mobile radio also needs to perform context activation as soon as it enters a new network. Therefore a mobile TETRA radio will attempt to perform context activation when it enters a cell which is under the control of a Foreign Agent.

Individual TETRA Subscriber Identity Mobility

Individual TETRA Subscriber Identity (ITSI) mobility is a proposal for mobile station mobility within the TETRA standard. This mobility is not based on an IP standard. It requires resource from voice capacity sensitive elements of the infrastructure, such as the Home Location Register (HLR).

A need exists to provide enhancements to the systems and proposals of the prior art.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates a single cell of a cellular radio system in accordance with the prior art.

FIG. **2** illustrates a Software and Measurement Infrastructure controlling five cells of a cellular radio system.

FIG. **3** illustrates one example of a cellular mobile station in accordance with the invention.

FIG. **4** illustrates the home and visited networks in an arrangement in accordance with the present invention.

FIG. **5** is a flowchart illustrating IP address allocation and mobile IP registration in accordance with the present invention, from the visited SwMI perspective.

FIG. **6** is a flowchart illustrating the decision process of the mobile station for requesting assignment of a static IP address, from the perspective of the mobile.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **3** illustrates a mobile station in accordance with the present invention. The mobile station of FIG. **3** is of the form of either a portable- or a mobile radio. However, a mobile telephone may be constructed to function analogously.

The radio **2** of FIG. **3** can transmit speech from a user of the radio. The radio comprises a microphone **34** which provides a signal for transmission by the radio. The signal from the microphone is transmitted by transmission circuit **22**. Transmission circuit **22** transmits via switch **24** and antenna **26**.

The transmitter **2** also has a controller **20** and a read only memory (ROM) **32**. Controller **20** is a microprocessor in the embodiment of FIG. **3**. ROM **32** is a permanent memory, and may be a non-volatile Electrically Erasable Programmable Read Only Memory (EEPROM). ROM **32** may contain various different regions of memory.

The radio **2** of FIG. **3** also comprises a display **42** and keypad **44**, which serve as part of the user interface circuitry of the radio. At least the keypad **44** portion of the user interface circuitry is activatable by the user. Voice activation of the radio, or other means of interaction with a user, may also be employed.

Signals received by the radio are routed by the switch **24** to receiving circuitry **28**. From there, the received signals are routed to controller **20** and audio processing circuitry **38**. A loudspeaker **40** is connected to audio circuit **38**. Loudspeaker **40** forms a further part of the user interface.

A data terminal **36** may be provided. Terminal **36** would provide a signal comprising data for transmission by transmitter circuit **22**, switch **24** and antenna **26**. Reception circuit **28** may be adapted to receive data. Received data may be provided from reception circuit **28** to data terminal **36**. The connection for this is not shown on FIG. **3**, for simplicity of illustration.

Radio **2** is also provided with a 'ready timer' **46** and a 'stand-by' timer **48**, whose function will be explained in greater detail later.

FIG. **4** shows an embodiment of a cellular radio communications system in accordance with the present invention. Radio **2** of FIG. **3** may be used in the arrangement of FIG. **4**. Mobile station **374** of FIG. **4** is a radio of the form shown in FIG. **3**.

The cellular radio communications system of FIG. **4** comprises at least one base station **358** for broadcasting radio signals to mobile stations, such as mobile station **374**, within a cell **350**. Mobile station **374** is addressable using IP addresses.

The cell **350** occupies the geographical territory schematically illustrated as being to the right of dividing line **290** on FIG. **4**. FIG. **4** also provides a schematic representation of another cell **210**. Cell **210** is part of a different network than cell **350**. Cells **210** and **350** are therefore under the control of different SwMIs.

The SwMIs controlling cells **210** and **350** are shown at the top of FIG. **4**. SwMI **200** controls cell **210**. SwMI **200** may control further cells, analogously to the arrangement of FIG. **2**. SwMI **300** controls cell **350**. SwMI **300** may control further cells, also analogously to the arrangement of FIG. **2**.

SwMI **300**, cell **350** and other cells controlled by SwMI **300** form a first network. SwMI **200**, cell **210** and other cells controlled by SwMI **200** form a different, second network.

Importantly, the mobile station **374** shown in cell **350** originates from cell **210**. Therefore SwMI **200** is the 'Home Agent' for mobile station **374**. Mobile station **374** therefore nominally 'belongs' to the second network.

FIG. **4** also shows two other mobile stations **372** and **376** in cell **350**. These may be other mobile stations that are visiting cell **350** from another network, exactly as mobile station **374** is visiting cell **350**. Alternatively, one or both of mobile stations **372** and **376** may normally reside in cell **350** or another cell controlled by SwMI **300**, and their home agent will therefore be SwMI **300**. The three mobile stations **202**, **204** and **206** in cell **210** may likewise normally reside in cell **210**, or elsewhere in the network controlled by SwMI **200**. However, mobiles **202**, **204** and **206** may be visiting cell **210** but normally reside in another network.

Mobile station **374** has entered cell **350**. From the perspective of mobile station **374**, cell **350** is under the control of a 'Foreign Agent'. The 'foreign agent' function for mobile station **374** is provided by SwMI **300**.

The foreign agent controls the assignment of IP addresses to mobile stations within cell **350**. In particular, the foreign agent fulfils the role of a first controller within cell **350**. Home agent **200** in cell **210** fulfils the role of a second controller within cell **210**.

SwMI **300** has been illustrated as being linked via connection **280** to SwMI **200**. A physical link is shown, which might for example be a fixed line such as a fibre optic link. However, the SwMIs **200** and **300** may be linked in other ways, such as by radio.

SwMI **300**, acting as a first controller for cell **350** of the first network of the cellular radio communications system, is adapted to receive a request from the mobile station **374** that the cellular radio communication system assign to mobile station **374** the static IP address previously assigned to the mobile station outside of cell **350**. If mobile station **374** had passed directly from cell **210** to cell **350**, then the request from mobile station **374** to SwMI **300**, acting as foreign, agent, would be for the same IP address as mobile station **374** had been using in cell **210**.

SwMI **300** is further adapted, in response to the request from mobile station **374**, to check with SwMI **200** associated with cell **210** that the static IP address requested has not been assigned to another mobile station. Although in this example mobile station **374** has passed directly from cell **210** to cell **350**, in general SwMI **300** is adapted to check with the controller of the cell in the location where the mobile station was previously registered. This may have been another foreign agent for mobile station **374**, not shown on FIG. **4**.

Finally, SwMI **300** is adapted to assign the static IP address previously assigned to mobile station **374**, outside of cell **350**, to mobile station **374** for use in cell **350**, if the static IP address has not been assigned to another mobile station. Registration with the Home Agent of SWMI **300** allows the forwarding of data packets to the SWMI **300** by tunnelling through the network. It is possible that the IP address previously assigned to mobile station **374**, outside of cell **350**, has been assigned by SwMI **200** to another mobile station, and is therefore no longer available to be assigned by SwMI **300** for use in cell **350**. It is also possible that another mobile station already within cell **350** has been given the IP address previously used by mobile station **374**, and that for this reason the IP address previously assigned to mobile station **374** is no longer available for assignment by SwMI **300** to mobile station **374** for use in cell **350**.

The embodiment of FIG. **4** has been explained in terms of SwMI **300** checking with the SwMI **200**, the controller in the location where the mobile station was previously registered, that the static IP address has not been assigned to another mobile station. However, an alternative embodiment of the invention is possible in which the foreign agent checks (that the static IP address has not been assigned to another mobile station) with a second controller that is formed by the SwMI associated with the location where the static IP address is registered. This would be appropriate where the IP address requested by the mobile station on entering cell **350** is identifiable as always belonging to a particular cell. The advantage of this arrangement is that, when a mobile station **374** roams through several networks, it would not then set up a whole chain of network controllers with which foreign agent of SwMI **300** would need to check the availability of the IP address requested by the mobile station **374**. Instead, the foreign agent of SwMI **300** could check immediately with the single cell where the static IP address remains registered.

Further enhancements of the cellular radio communications system of the invention are possible. The SwMI **300**, acting as first controller, may be further adapted to perform mobile IP registration with the home agent SwMI **200**, acting as the second controller, on behalf of mobile station **374**. This would provide forwarding of IP packet data to mobile station **374** in cell **350**, without the mobile station **374** being a mobile IP capable terminal. Mobile station **374**

could then be a simpler terminal without such added functionality. Such an arrangement therefore has the advantage of providing complete IP mobility for mobile stations, using only adaptations to the SwMI of the network which controls cell **350**. No adaptation of the mobile station, for example a TETRA radio, would be necessary to facilitate this network roaming. Using the principle of the present invention therefore, an IP addressable mobile station can therefore also be transformed into a roaming mobile IP station, with only changes to the network's infrastructure. This facilitates mobile IP addressing for existing TETRA mobile stations, and can reduce the complexity of future mobile IP stations.

If SwMI **300**, acting as first controller, is further adapted to perform mobile IP registration with the home agent SwMI **200** on behalf of mobile station **374**, then the SwMI **300** may utilise the mobile station's ITSI number to do this. The ITSI number allows the SWMI to access details of the mobile station stored in the Home Location Register (HLR) of the home SWMI.

FIG. **4** illustrates an arrangement whereby mobile **374** has 'roamed' from one mobile communications network to another. However, mobile **374** may instead initially be connected to a Local Area Network (LAN), for example via a cabled connection at an office workspace. Mobile **374** may then be removed from its wired connection by the user, and need to establish communication through a mobile network. Such a transition may occur similarly to the roaming shown in FIG. **4**. A transition from a mobile network back to a fixed LAN may occur analogously.

Mobile station **374** comprises a ready timer **46**. Mobile station **374** also comprises a stand-by timer **48**. See FIG. **3**.

In operation, mobile station **374** performs context activation on entering cell **350**. This is because mobile station **374** needs to communicate through SwMI **300**, whereas it has previously communicated, in this example, through SwMI **200**. However, mobile station **374** may be adapted to check with either a stand-by timer or a ready timer before requesting the static IP address. Mobile station **374** may be adapted to request the same IP address as it had outside of cell **350** only if one of these timers has not timed out.

Mobile station **374** may be adapted:

(i) to check whether ready timer **46** has timed out, and

(ii) if ready timer **374** has not timed out, to request assignment of the static IP address previously assigned to mobile station **374** outside of cell **350**.

Mobile station **374** may perform the check whether ready timer **46** has timed out at the time of first context activation in the cell. This will therefore ensure that mobile station **374** requests assignment of the static IP address previously assigned to mobile station **374** outside of cell **350** if mobile station **374** is in the act of transmitting or receiving data at the time of entering cell **350**. There is great advantage to mobile station **374** in doing this, since it will ensure that a data exchange which is in progress as mobile station **374** enters cell **350** will continue and be completed using the same IP address throughout the exchange. This enhances the chance of all the IP data packets in the exchange successfully reaching mobile station **374**.

Mobile station **374** may alternatively be adapted:

(i) to check whether the stand-by timer **48** of the mobile station has timed out; and

(ii) if the stand-by timer **48** has not timed out, to request assignment of the static IP address previously assigned to mobile station **374** outside of cell **350**.

Mobile station **374** may perform the check whether the stand-by timer **48** has timed out at the time of first context activation in cell **350**. Thus mobile station **374** will request the static IP address previously assigned to it outside of cell **350** if it is either active or in the idle state at the time of entering cell **350**.

Cell **350** may be part of an administrative unit of the cellular radio communication system having a different pool of IP addresses than the location where mobile station **374** was previously registered. This is the case in the example of FIG. **4**, the administrative function of assigning IP addresses being performed by SwMI **300**, and cell **350** is under the control of a different Switching and Management Infrastructure (SwMI) than the location where the mobile station was previously registered. The cellular radio communication system of the invention may be part of a packet switched data network.

An alternative embodiment was discussed above where the SwMI **300**, acting as foreign agent, checks with a second controller associated with the location where the static IP address is registered that the static IP address has not been assigned to another mobile station. In this case cell **350** may be part of an administrative unit of the cellular radio communication system having a different pool of IP addresses than the location where the static IP address is registered. In the example of FIG. **4**, the first controller is constituted by the SwMI data controller of cell **350**, and cell **350** is under the control of a different Switching and Management Infrastructure (SwMI) than the location where the static IP address is registered. The data controller of a SWMI may have several functions. These are typically the routing of data packets, the tunnelling of data packets from one SWMI to another, and the management, including assignment, of IP addresses.

SwMI **300** may be adapted to assign a new IP address to mobile station **374** from the pool of available IP addresses in the network controlled by SwMI **300** if the static IP address previously assigned to the mobile station outside of the cell has been assigned to another mobile station.

This would mean that the request by mobile station **374** for the static IP address which it had used prior to entering the cell would be unsuccessful. However, this would ensure that mobile station **374** would not be assigned an IP address currently assigned to mobile stations such as **372** or **376**. The new IP address assigned to mobile station **374** would then be a dynamic IP address.

Viewed in general terms, the invention provides a technique for roaming between SWMIs. During context activation the mobile station **374** receives an IP address. Outside of its home network, mobile station **374** may claim a static IP address as part of the context activation.

As a mobile station in accordance with the invention roams from its home SWMI to a visited SwMI, new context activation is performed. The invention proposes a traffic mobility, which is based on mobile IP functionality as described in RFC 2002. However, the mobile node functionality is not located in the mobile station. This functionality exists in the visited SwMI infrastructure. The static IP address provided to the roaming mobile station is handled as a mobile IP address by the infrastructure and as an ordinary static IP address by the mobile station.

When the mobile station roams to a visited SwMI constructed in accordance with the present invention, the mobile station may check if its ready timer is on, or may check if the stand-by timer is on. Based on the conditions of one of these timers, the mobile station decides whether or not it wishes to keep the same IP address as previously, in order to keep the IP session alive. If the relevant timer is on, the mobile station requests the same static address as had been

allocated by the home SwMI. The visited SwMI checks with the home SwMI if the IP address can still be used. If the answer is yes, then the visited SwMI may perform mobile IP registration on behalf of the mobile station with the home agent, which may in fact reside either in the home SwMI or on the Internet.

The home agent then forwards packets of data addressed for that mobile station to the visited SWMI. The visited SMMI also performs mobile IP Foreign Agent functionality.

If the mobile is an idle state when it enters the visited cell, the mobile station may not request any specific address type. Then the visited SwMI may allocate either a static or a new dynamic address to the mobile station. In the static case the SwMI will allocate the old IP address after verifying with the home SwMI. The visited SwMI will also perform mobile IP registration in the home agent to provide the mobility. If the visited SwMI allocates a dynamic IP address to the mobile station from the pool of IP addresses available to the visited SwMI, then the visited SwMI could perform mobile IP registration of the dynamic IP address in order to provide mobility for that dynamic IP, in a case where the mobile station roams while in a ready state.

The advantages of the invention include providing mobility between SwMIs and maintaining an ongoing IP communication session after roaming to a visited SwMI which normally supports dynamic IP address allocation.

A practical example of roaming between different networks whilst in an ongoing communication would be as follows. An IP addressable TETRA radio may, for example, be operating at the edge of its home network. It may at this time be exchanging packets of data via a radio base station belonging to that network. During this exchange, the TETRA radio may pass into another network, for example that owned by a different company. With the arrangement of the invention, the radio would be able to continue data exchange using the same IP address as it had been using in the home network. The mobile IP registration would be taken care of by the foreign agent (SwMI) in the new network. Forwarding of IP data packets would be carried out by the home agent. This provides continuity of service and a reduced likelihood of losing the call, in comparison to networks which lack the arrangement of the invention.

In addition to the cellular radio communications system explained above, the invention also encompasses a method of mobile station registration in a cellular radio communication system.

The present invention relates to a cellular radio communication system comprising at least one base station for broadcasting radio signals to mobile stations within a cell. The method of mobile station registration in accordance with the invention comprises:

a) a mobile station entering a cell of the cellular radio communication system, the mobile station being addressable using IP addresses;

b) the mobile station requesting that the cellular radio communication system assign to the mobile station the static IP address previously assigned to the mobile station outside of the cell; and

c) a first controller associated with the cell checking with a second controller associated with the location where the mobile station was previously registered that the static IP address has not been assigned to another mobile station, and,

if the static IP address has not been assigned to another mobile station, the first controller assigning the static IP address previously assigned to the mobile station, outside of the cell, to the mobile station for use in the cell.

An alternative method in accordance with the present invention is possible. This alternative method comprises steps a)–c) above, however in step c) the first controller associated with the cell checks with a second controller associated with the location where the static IP address is registered that the static IP address has not been assigned to another mobile station. This replaces the check with a second controller associated with the location where the mobile station was previously registered, in step c) above.

FIG. **5** is a flowchart illustrating IP address allocation and mobile IP registration in accordance with the present invention, from the perspective of the visited SWMI.

Starting at box **502**, a mobile roams into an area served by a 'visited' SWMI. If the visited SWMI does not prefer dynamic IP address allocation, see box **504**, then the check is made with the home SWMI whether or not the mobile's static IP address is available, see box **506**.

If the static IP address is available, then the visited SWMI performs mobile IP registration with the Home Agent, see box **518**, and context acceptance indicates approval of the static IP address, see box **520**. Then the mobile returns to the standby state, see box **514**.

If the check in box **506** reveals that the static IP address is not available, then the visited SWMI allocates a dynamic IP address to the mobile from the pool of IP addresses available to the SWMI, see box **508**. The SWMI then performs mobile IP registration in the local Home Agent, see box **510**. Step **510** is shown in a dotted box because it is an optional step. The registration of step **510** is usually with the Home Agent of the visited SWMI. The SWMI could be arranged to use Mobile IP addresses from its dynamic pool in order to provide mobility within the SWMI during local sessions.

The dynamic IP address is provided to the mobile via the context acceptance, see box **512**. Then the mobile returns to the standby state, see box **514**.

If in the check of box **504** the visited SWMI is found to prefer dynamic IP address allocation, then, the mobile may ask for a static IP address to be assigned to it, see box **516**. In this case, the process moves to box **506**, described above. If the mobile does not ask for a static IP address to be assigned to it, then the process moves from box **516** to box **508**, described above.

Thus FIG. **5** shows one process in accordance with the invention.

The step of box **506** may comprise checking with either the location where the mobile was previously registered, or checking with the location where the requested static IP address is registered.

FIG. **6** is a flowchart illustrating the decision process of the mobile station for requesting assignment of a static IP address, from the perspective of the mobile.

Starting at box **602**, a mobile roams into an area served by a 'visited' SWMI. If the mobile's ready timer is not in the 'on' state, see box **604**, then the mobile checks its stand-by timer, see box **606**. If the stand-by **5** timer is on, then the mobile checks whether an application is 'open' on the radio, see box **608**. An open application is one which is running on the radio. The radio therefore checks in box **608** whether any of its applications is currently running. An example of an application would be an internet browser running on a Motorola 'iDEN' radio.

If there is no application open, or if box **606** produced the result that the stand-by timer was not on, then the mobile does not specify an IP address during context activation, see box **610**. The mobile then receives an IP address via the context acceptance, see box **612**, and finally is in a stand-by state, see box **614**.

If either the ready timer is on, see box **604**, or the stand-by timer is on and there is an application open on the radio, see box **608**, then the mobile requests a static IP address during context activation. See box **616**. The mobile may then receive an approval for the static IP address via the context acceptance, see box **618**. The mobile then uses the packet data channel to continue to transmit or receive packets of data, using the static IP address, see box **620**. Finally, the mobile is in a ready state, see box **622**.

The 'context accept' message of boxes **512, 520, 612** and **618** is a message sent from the SWMI to the mobile station. The context accept message informs the mobile of the IP address which it must use.

What is claimed is:

1. A cellular radio communications system having at least a first and second radio network having different geographical coverage areas, the cellular radio communication system comprising:

a non-mobile-IP capable mobile station addressable using IP addresses, the mobile station being adapted to roam between the first and second radio network, the first network comprising a home network of the mobile station and the second network comprising a foreign network of the mobile station;

a fast controller associated with the first network; and

a second controller comprising infrastructure equipment associated with die second network, the second controller being adapted upon the mobile station roaming from the first network to the second network:

(i) to receive a context activation request from the mobile station that the cellular radio communication system assign to the mobile station a static IP address previously assigned to the mobile station by the first controller;

(ii) in response to the request from the mobile station, to check with the first controller that the static IP address has not been assigned to another mobile station;

(iii) to assign the static IP address previously assigned to the mobile station by the first controller, to the mobile station for use in the second network, if the static IP address has not been assigned to another mobile station; and

(iv) to perform mobile IP registration with the first controller on behalf of the mobile station.

2. A system in accordance with claim **1**, wherein the mobile station comprises a ready timer, the mobile station being adapted:

(i) to check whether the ready timer has timed out, and

(ii) if the ready timer has not timed out, to request assignment of the static IP address.

3. A system in accordance with claim **2**, wherein the mobile station is adapted to perform the check whether the ready timer has timed out at the time of first context activation in the second network.

4. A system in accordance with claim **1**, wherein the mobile station comprises a stand-by timer, and the mobile station is adapted:

(i) to check whether the stand-by timer of the mobile station has timed out; and

(ii) if the stand-by timer has not timed out, to request assignment of the static IP address.

5. A system in accordance with claim **4**, wherein the mobile station is adapted to perform the check whether the stand-by timer has timed out at the time of first context activation in the second network.

6. A system in accordance with claim **1**, wherein the second network is an administrative unit of the cellular radio communication system having a different pool of IP addresses than the first network.

7. A system in accordance with claim **1**, wherein the first controller is the SwMI data controller of the first network, and the second network is under the control of a different Switching and Management Infrastructure (SwMI) than the first network.

8. A system in accordance with claim **1**, wherein the cellular radio communication system is part of a packet switched data network.

9. A system in accordance with claim **1**, wherein the second controller is adapted to assign a new IP address to the mobile station from the pool of available IP addresses for the second network if the static IP address previously assigned to the mobile station by the first controller has been assigned to another mobile station.

10. A system in accordance with claim **9**, wherein the new IP address is a dynamic IP address.

11. The cellular radio communication system of claim **1** wherein the first controller is a home agent of the mobile station in accordance with mobile internet protocol.

12. The cellular radio communication system of claim **1** wherein the second controller is a foreign agent of the mobile station in accordance with mobile internet protocol.

13. A method of mobile station registration in a cellular radio communication system, the cellular radio communication system comprising a plurality of radio networks having different geographical coverage areas, the method of mobile station registration comprising:

a non-mobile-IP-capable mobile station entering a foreign network of the plurality of networks, the mobile station being addressable using IP addresses;

the mobile station requesting that the cellular radio communication system assign to the mobile station the static IP address previously assigned to the mobile station while in a home network of the plurality of networks; and

a first controller comprising infrastructure equipment associated with the foreign network checking with a second controller associated with the home network that the static IP address has not been assigned to another mobile station, and, if the static IP address has not been assigned to another mobile station, the first controller assigning the static IP address previously assigned to the mobile station, while in the home network, to the mobile station for use while in the foreign network; and the first controller performing mobile IP registration with the second controller on behalf of the mobile station.

14. A method in accordance with claim **13**, wherein the mobile station checks whether a ready timer of the mobile station has timed out, and, if the ready timer has not timed out, then the mobile station requests assignment of the static IP address.

15. A method in accordance with claim **14**, wherein the mobile station performs the check whether the ready timer has timed out at the time of first context activation upon entering the foreign network.

16. A method in accordance with claim **13**, wherein the mobile station checks whether a stand-by timer of the mobile station has timed out, and, if the stand-by timer has not timed out, then the mobile station requests assignment of the static IP address.

17. A method in accordance with claim **16**, wherein the mobile station performs the check whether the stand-by

timer of the mobile station has timed out at the time of first context activation upon entering the foreign network.

18. A method in accordance with claim **13**, wherein the foreign network is an administrative unit of the cellular radio communication system having a different pool of IP addresses than the home network.

19. A method in accordance with claim **13**, wherein the foreign network is under the control of a different Switching and Management Infrastructure (SwMI) than the home network.

20. A method in accordance with claim **13**, wherein the cellular radio communication system is part of a packet switched data network.

21. A method in accordance with claim **13**, wherein, if the static IP address previously assigned to the mobile station while in the home network has been assigned to another mobile station, then the first controller assigns a new IP address to the mobile station from the pool of available IP addresses in the foreign network.

22. A method in accordance with claim **21**, wherein the new IP address is a dynamic IP address.

23. The method of claim **13** wherein the second controller is a home agent of the mobile station in accordance with mobile internet protocol.

* * * * *

US005570365A

United States Patent [19]

Yoshida

[11] Patent Number: 5,570,365

[45] Date of Patent: Oct. 29, 1996

[54] **LAN BRIDGE USING GATE CIRCUITS FOR PROTECTING HIGH-PRIORITY PACKETS FROM LOW-PRIORITY PACKET TRANSMISSIONS**

[75] Inventor: **Atsushi Yoshida**, Tokyo, Japan

[73] Assignee: **NEC Corporation**, Japan

[21] Appl. No.: **399,902**

[22] Filed: **Mar. 8, 1995**

[30] **Foreign Application Priority Data**

Mar. 9, 1994 [JP] Japan 6-066749

[51] **Int. Cl.**[6] **H04L 12/46**

[52] **U.S. Cl.** **370/85.6**; 370/85.13; 370/60

[58] **Field of Search** 370/60, 60.1, 85.6, 370/85.13, 85.14, 94.1, 94.2

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,058,109	10/1991	Goldberg et al.	370/85.13
5,132,966	7/1992	Hayano et al.	370/79
5,144,622	9/1992	Takiyasu et al.	370/85.13
5,390,176	2/1995	Schoute et al.	370/60.1
5,461,611	10/1995	Drake, Jr. et al.	370/54

FOREIGN PATENT DOCUMENTS

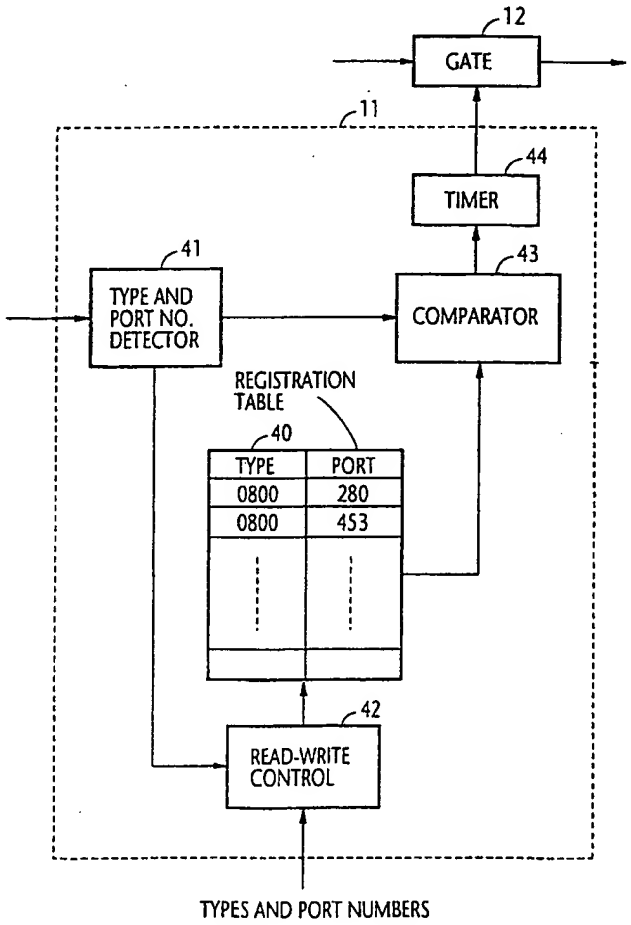
1-189252 7/1989 Japan H04L 11/00

Primary Examiner—Douglas W. Olms
Assistant Examiner—Russell W. Blum
Attorney, Agent, or Firm—Ostrolenk, Faber, Gerb & Soffen, LLP

[57] **ABSTRACT**

In a bridge for interconnecting local area networks, header detectors are associated respectively with the LANs for detecting a packet header contained in a packet transmitted from the associated LAN to a destination LAN. Registration tables are associated respectively with the LANs to store information representing packets which are to be protected from interference by other packets. Comparators are respectively associated with the header detectors as well as with the registration tables for comparing the packet header detected by the associated header detector with the information stored in the associated registration table to detect a match or mismatch. Gate circuits are associated respectively with the comparators for responding to the match for preventing the other packets from being forwarded to the destination LAN and responding to the mismatch for allowing the other packets to be forwarded to the destination LAN.

9 Claims, 4 Drawing Sheets



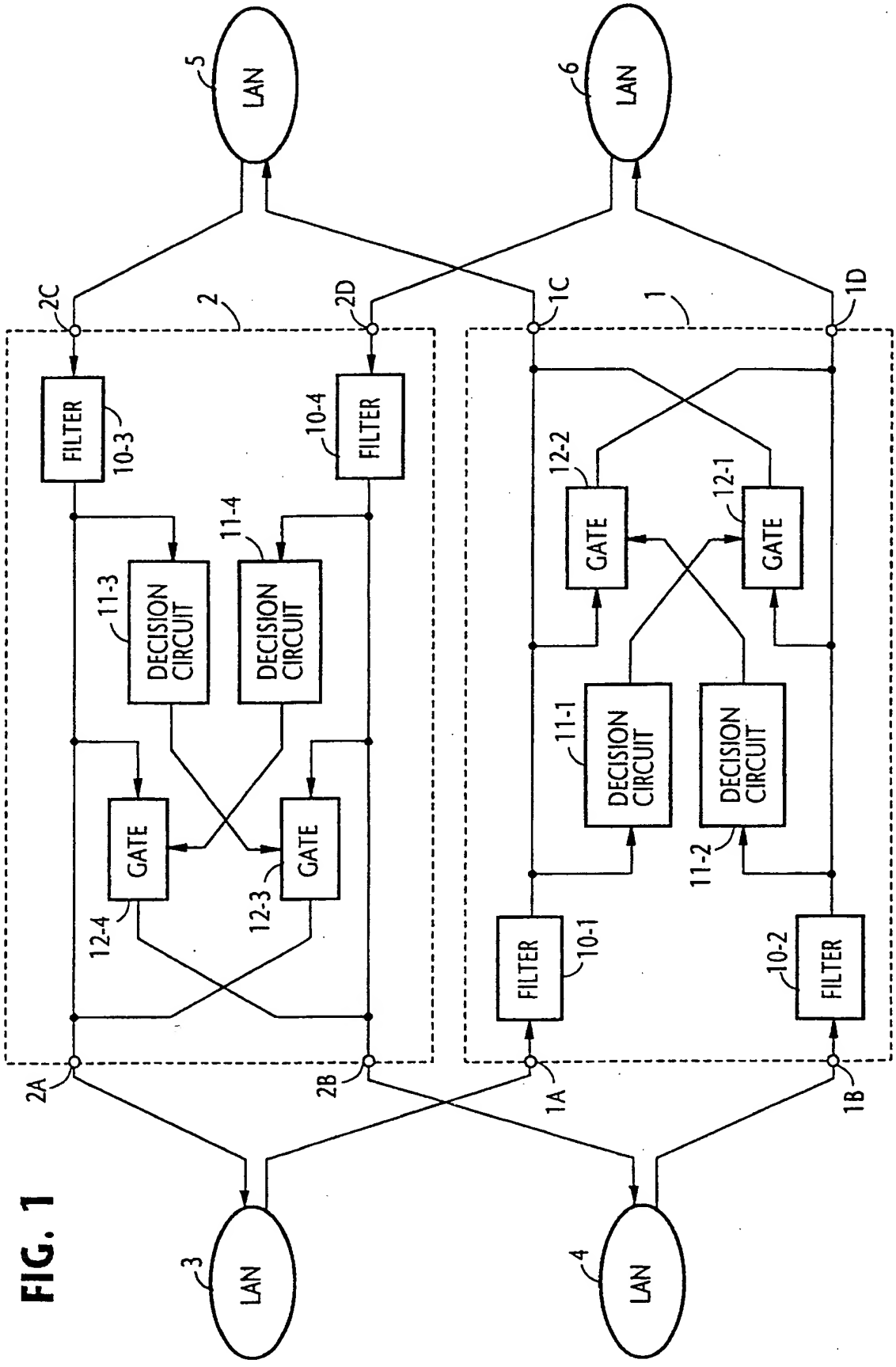

5
LAN
6
LAN
2C
2
2D
1C
1
1D
FILTER
10-3
10-4
FILTER
11-4
11-3
DECISION CIRCUIT
DECISION CIRCUIT
GATE
GATE
12-4
12-3
12-2
12-1
GATE
GATE
11-1
DECISION CIRCUIT
DECISION CIRCUIT
11-2
FILTER
10-1
10-2
FILTER
2A
2B
1A
1B
3
LAN
4
LAN

FIG. 1

FIG. 2

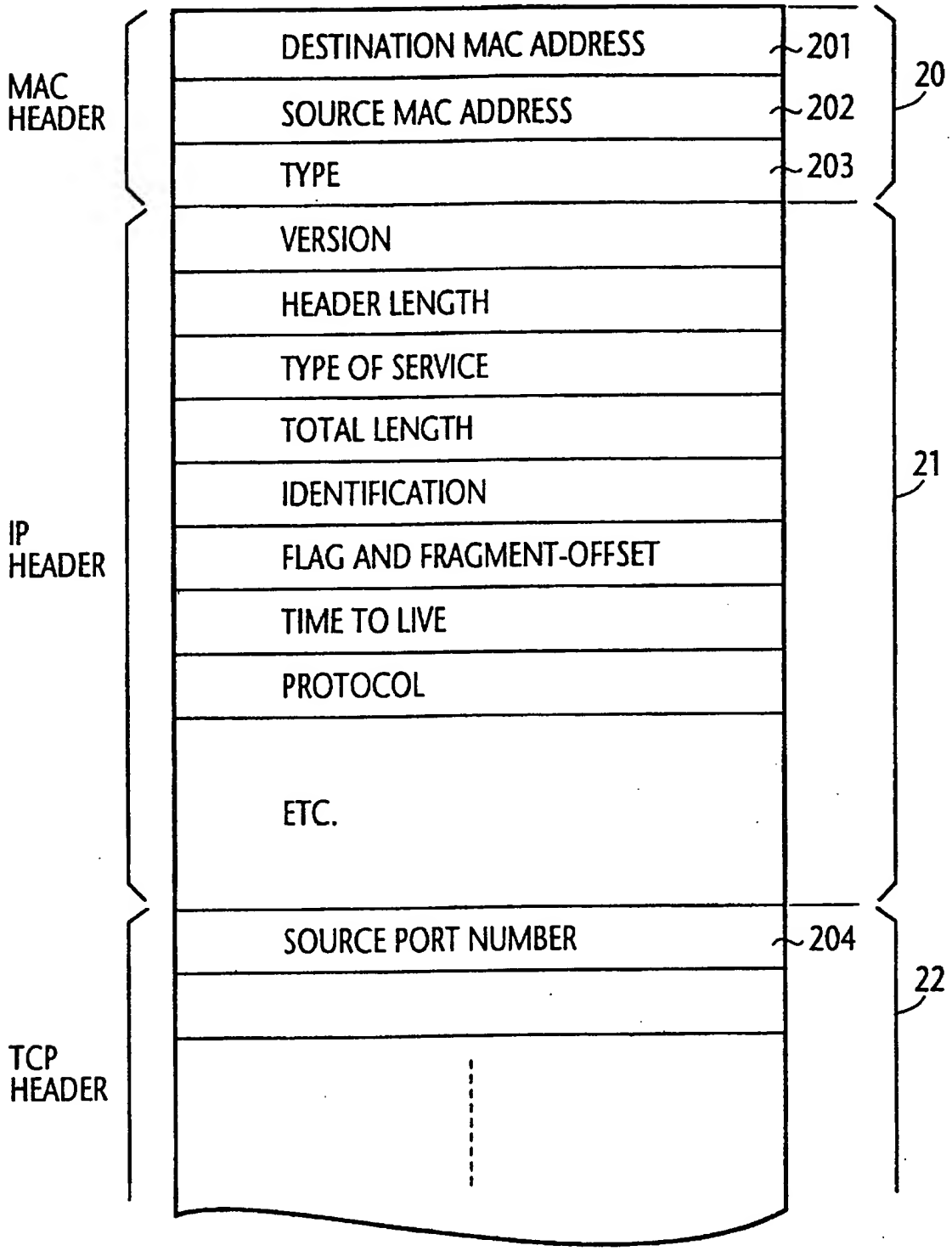

MAC HEADER
IP HEADER
TCP HEADER
DESTINATION MAC ADDRESS
201
SOURCE MAC ADDRESS
202
TYPE
203
20
VERSION
HEADER LENGTH
TYPE OF SERVICE
TOTAL LENGTH
IDENTIFICATION
FLAG AND FRAGMENT-OFFSET
TIME TO LIVE
PROTOCOL
ETC.
21
SOURCE PORT NUMBER
204
22

FIG. 3

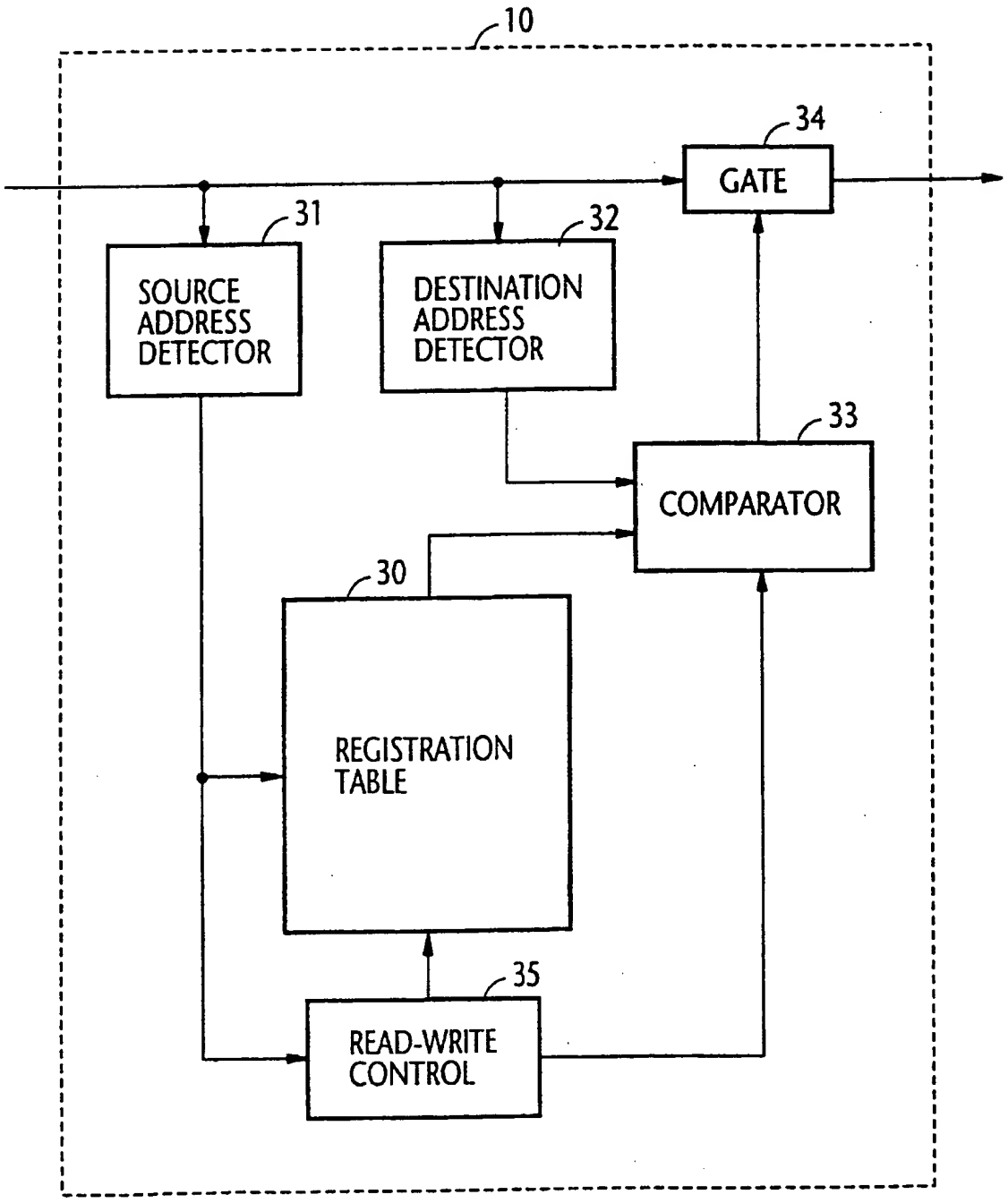
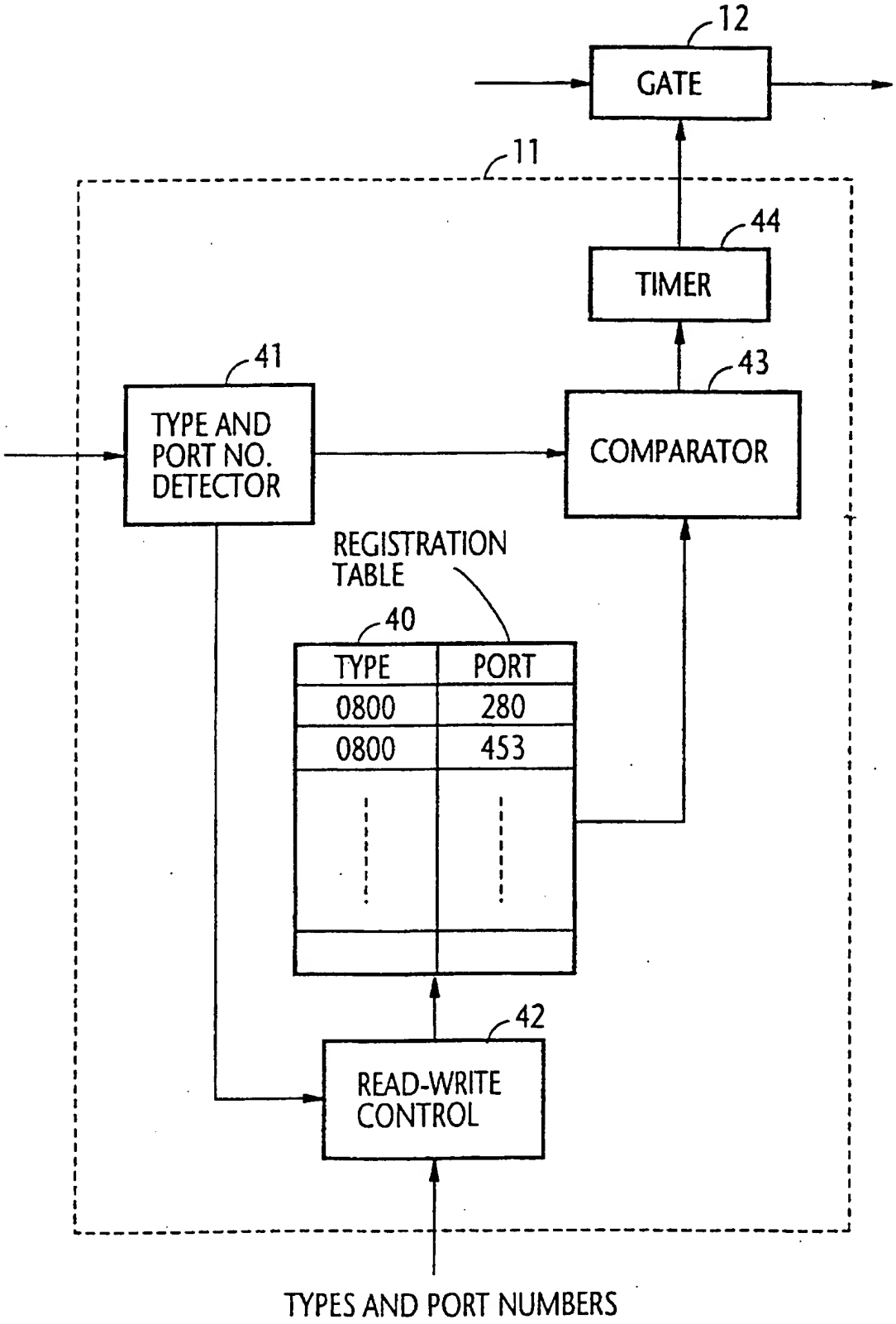

10
34
GATE
31
SOURCE ADDRESS DETECTOR
32
DESTINATION ADDRESS DETECTOR
33
COMPARATOR
30
REGISTRATION TABLE
35
READ-WRITE CONTROL

FIG. 4


12
GATE
11
44
TIMER
41
43
TYPE AND PORT NO. DETECTOR
COMPARATOR
REGISTRATION TABLE
40
TYPE
PORT
0800
280
0800
453
42
READ-WRITE CONTROL
TYPES AND PORT NUMBERS

LAN BRIDGE USING GATE CIRCUITS FOR PROTECTING HIGH-PRIORITY PACKETS FROM LOW-PRIORITY PACKET TRANSMISSIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to local area networks, and more specifically to a bridge for interconnecting local area networks at OSI (Open System Interconnection Reference Model) physical and data link layers.

2. Description of the Related Art

For interconnecting local area networks at the OSI lower two layers, a device called "layer-2 relay", or "bridge" is used. The conventional LAN bridge includes an address filter associated with one of the local area networks for allowing only those packets destined to local area networks other than the associated local area network to be forwarded from the bridge through an output port. Thus, packets destined to the home local area network are rejected by the bridge. Specifically, the address filter has a source address detector, a destination address detector and a registration table. The source address detector extracts a source address from a packet arriving from the associated local area network, the extracted source address being stored into the registration table. The destination address detector extracts a destination address from the packet. The registration table is then searched for an address identical to the extracted destination address. If the same destination address is stored in the registration table, the transmission of the packet from the bridge is prevented. If the same destination address is not detected in the registration table, it is recognized that the packet is destined to a local area network other than the associated network, and the packet is forwarded from the bridge. Such LAN bridges are usually provided one for each direction of transmission between two LANs so that all the LANs are interconnected to allow the terminals of each LAN to access the terminals of other networks. Therefore, the packets directed to a particular LAN are also transported to other LANs as well. For purposes of network management and maintenance, the bridge is also designed to relay broadcast packets specified by the protocol of the OSI network layer. Since the OSI network layer recognizes all the interconnected networks as a single entity, the broadcast packet from each LAN is transported to all the other local area networks.

Recent advances in technologies permit transmission of high-priority packets such as those transmitted using multimedia application software. However, such high priority packets are vulnerable to delays which would be caused by the transmission of low-priority packets destined to other local area networks over the common network facility as well as by broadcast packets.

Japanese Provisional Patent Publication (Tokkai-Hei) 1-189252 discloses a LAN bridge that prevents packets from being forwarded onto the common facility of an interconnected LAN network by appending a special code to each packet. However, protocols must be altered to prevent transfer of such packets.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a LAN bridge which prevents the transmission of unnecessary packets without altering OSI protocols.

According to a broader aspect, the present invention provides a bridge for interconnecting a plurality of local area networks. The LAN bridge comprises a header detector for detecting a packet header contained in a packet transmitted from a first local area network to a second local area network, a registration table for storing information representing packets which are to be protected from interference by other packets, a comparator for comparing the packet header detected by the header detector with the information stored in the registration table to detect a match or mismatch, and a gate circuit responsive to a match detected by the comparator for preventing the other packets from being forwarded to the second local area network and responsive to a mismatch detected by the comparator for allowing the other packets to be forwarded to the second local area network.

In a specific aspect, the information stored in the registration table represents a packet header that identifies multimedia application software.

According to a further specific aspect, a bridge for interconnecting a plurality of local area networks comprises a plurality of header detectors associated respectively with the local area networks, each of the header detectors detecting a packet header contained in a packet transmitted from the associated local area network to a destination local area network, a plurality of registration tables associated respectively with the local area networks, each of the registration tables storing information representing packets which are to be protected from interference by other packets, a plurality of comparators respectively associated with the header detectors and respectively associated with the registration tables, each of the comparators comparing the packet header detected by the associated header detector with the information stored in the associated registration table to detect a match or mismatch, and a plurality of gate circuits associated respectively with the comparators, each of the gate circuits being responsive to a match detected by the associated comparator for preventing the other packets from being forwarded to the destination local area network and responsive to a mismatch detected by the associated comparator for allowing the other packets to be forwarded to the destination local area network.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described in further detail with reference to the accompanying drawings, in which:

FIG. 1 is a block diagram of local area networks interconnected by bridges constructed according to the present invention;

FIG. 2 is an illustration of the format of packets used in the local area networks;

FIG. 3 is a block diagram of each address filter of FIG. 1; and

FIG. 4 is a block diagram of each decision circuit of FIG. 1.

DETAILED DESCRIPTION

Referring now to FIG. 1, there is shown 4-port LAN bridges 1 and 2 of identical configuration for interconnecting local area networks 3, 4, 5 AND 6. The bridges 1 and 2 are preferably located at equal distances from the LANs 3 to 6. The LAN bridge 1 is used for establishing connections from LANs 3 and 4 to LANs 5 and 6 and the bridge 2 for establishing connections from LANs 5 and 6 to LANs 3 and

4. Bridge **1** includes address filters **10-1** and **10-2**, decision circuit **11-1** and **11-2**, and gate circuit **12-1** and **12-2**. The address filters **10-1** and **10-2** receive signals from LANs **3** and **4**, respectively, via input ports **1A** and **1B** and supply their outputs to the decision circuits **11-1** and **11-2**, respectively. The gate circuit **12-1** is connected between the output of filter **10-2** and an output port **1C** which leads to LAN **5** and the gate circuit **12-2** is connected between the output of filter **10-1** and an output port **1D** leading to LAN **6**. In like manner, bridge **2** includes address filters **10-3** and **10-4**, decision circuit **11-3** and **11-4**, and gate circuits **12-3** and **12-4**. The address filters **10-3** and **10-4** receive signals from LANs **5** and **6** via input ports **2C** and **2D** and supply their outputs to the decision circuits **11-3** and **11-4**, respectively. The gate circuit **12-3** is connected between the output of filter **10-4** and an output port **2A** which leads to LAN **3** and the gate circuit **12-4** is connected between the output of filter **10-4** and an output port **2B** leading to LAN **4**. Each of the address filters **10-1** to **10-4** is cleared at periodic intervals.

Each of the decision circuits holds the header information of packets to be rejected and compares the header of each incoming packet with each of the stored headers. If a coincidence is detected, the decision circuit turns off the associated gate circuit to prevent the matched incoming packet from being forwarded onto the outgoing terminal.

As a typical example shown in FIG. **2**, each packet is formatted as comprising a MAC (media access control) header **20** corresponding to the MAC layer (a lower subdivision of the OSI data link control layer), and an Internet Protocol (IP) header **21** and a Transmission Control Protocol (TCP) header **22** corresponding respectively to the OSI network and transport layers. The MAC header **20** contains a destination MAC address field **201**, a source MAC address field **202** and a type field **203**. Since the present invention is concerned with TCP/IP, a code "0800" is stored in the type field **203**. If Xerox Network System (ZNS) is used, a code "0600" will be stored in the type field. The IP header **21** includes a version field, a header-length field indicating the header length of the IP packet, a type-of-service field, a total-length field, an identification field for identifying fragmented data, a flag-and-fragment-offset field for indicating the positions of fragmented data in the original packet, a time-to-live field for indicating the length of time during which a packet exists in the network, a protocol field identifying the protocol of the upper layer, and other fields. The TCP header **22** includes interalia a source port number field **204** which identifies the port of a source host. The combination of data in the type field **203** and data in the source port number field **202** indicates the type of particular application software used in the upper layer.

As illustrated in FIG. **3**, each of the filters **10** comprises a registration table **30**, a source address detector **31**, a destination address detector **32**, a comparator **33**, a gate circuit **34** and a read/write controller **35**. A packet from the associated LAN is supplied to the source address detector **31** and destination address detector **32** as well as to gate circuit **34**. Source address detector **31** extracts the source MAC address from the packet and stores it into the table **30** into a location specified the read/write controller **35** if it is not already stored in the table. Read/write controller **35** causes the registration table to sequentially read the stored addresses to the comparator **33**. Destination address detector **32** extracts the destination MAC address from the packet and supplies it to the comparator **33** where it is compared with each of the addresses read out of the registration table **30**. If the same MAC address is detected, comparator **33** recognizes that the packet is destined to the home network and turns off the gate circuit **34** to prevent the packet from being forwarded from the filter **10** to the associated output port. If the same MAC address is not detected in the decision circuit **11-1**, for example, the comparator **33** of the decision circuit recognizes that the packet is destined to other networks and turns on the gate circuit **34** to allow it to be forwarded onto LAN **5** via the associated output port **1C** as well as to LAN **6** through the gate circuit **12-2** if the latter is gated on in a manner will be described hereinbelow.

FIG. **4** shows details of each decision circuit **11**. The decision circuit includes a registration table **40**, a type-and-port-number detector **41**, a read/write controller **42**, a comparator **40** and a timer **44**. The registration table **40** has a plurality of entries for storing types and port numbers supplied via the read/write controller **42** from an external source, not shown, to identify those multimedia application software whose transmissions are to be protected from transmissions from other local area networks. Detector **41** extracts the type field **203** and source port number field **204** from each incoming packet supplied from the associated address filter and supplies the extracted type and port number data to the comparator **43**. Read/write controller **42** responds to the arrival of the packet at the detector **41** for sequentially reading each combination of the stored types and port numbers data out of the table **40** into the comparator **43** where it is compared against the data extracted by the detector **41**. If they match, comparator **43** activates the timer **44**. Timer **44** produces a pulse for a period ranging from 30 seconds to 3 minutes depending on the type of applications. The output pulse of the timer **44** is supplied to the control terminal of the associated gate circuit **12** so that the gate circuit **12**, which is normally in a turn-on state, is turned off to prevent the passage of packets therethrough.

If the registration table **40** of decision circuit **11-1** stores codes "0800" and "280" in the type and port number fields, respectively, for example, and if multimedia application packets containing the corresponding header information are transmitted from LAN **3** to LAN **5**, the comparator **43** of decision circuit **11-1** detects a coincidence and activates the timer **44**. Therefore, the gate circuit **12-1** is turned off for a period of time specified by the timer **44**. If non-multimedia packet data are simultaneously transmitted from LAN **4** to LAN **6**, such non-multimedia packets are prevented by the gate circuit **12-1** from being forwarded onto output port **1C**. Thus, for the specified time interval, the multimedia transmission from LAN **3** to LAN **5** is not interfered with non-multimedia transmissions from LAN **4** to LAN **6**. Because of the non-multimedia application packets from LAN **4** to LAN **6**, decision circuit **11-2** keeps the gate circuit **12-2** in the turn-on state, allowing multimedia packets from LAN **4** to be forwarded onto LAN **6** via output port **1D** as well as to LAN **5** via output port **1C**.

What is claimed is:

1. A bridge for interconnecting a plurality of local area networks, comprising:

header detector means for detecting a packet header contained in a packet transmitted from a first local area network to a second local area network;

registration means for storing information representing packets which are to be protected from interference by other packets;

comparator means for comparing the packet header detected by said header detector means with the information stored in the registration means to detect a match or mismatch;

gate means responsive to a match detected by said comparator means for preventing said other packets from

being forwarded to said second local area network and responsive to a mismatch detected by said comparator means for allowing said other packets to be forwarded to said second local area network; and

timer means responsive to a match detected by said comparator means for preventing said other packets from being forwarded to said second local are network for a specified period of time.

2. A bridge as claimed in claim 1, wherein the information stored In said registration means represents a packet header identifying multimedia application software.

3. A bridge as claimed in claim 1, further comprising address filter means for allowing packets from said first local area network to be forwarded to said second local area network if said packets are destined to local area network other than said first local area network.

4. A bridge for interconnecting a plurality of local area networks, comprising:

a plurality of header detectors associated respectively with said local area networks, each of the header detectors detecting a packet header contained in a packet transmitted from the associated local area network to a destination local area network;

a plurality of registration tables associated respectively with said local area networks, each of the registration tables storing information representing packets which are to be protected from interference by other packets;

a plurality of comparators respectively associated with said header detectors and respectively associated with said registration tables, each of the comparators comparing the packet header detected by the associated header detector with the information stored in the associated registration table to detect a match or mismatch;

a plurality of gate circuits associated respectively with said comparators, each of the gate circuits being responsive to a match detected by the associated comparator for preventing said other packets from being forwarded to said destination local area network and responsive to a mismatch detected by the associated comparator for allowing said other packets to be forwarded to said destination local area network; and

a plurality of timers associated respectively with said comparators and associated respectively with said gate circuits, each of the timers being responsive to a match detected by the associated comparator for preventing said other packets from being forwarded through the associated gate circuit to said destination local area network for a specified period of time.

5. A bridge as claimed in claim 4, wherein the information stored in each of said registration tables represents a packet header identifying multimedia application software.

6. A bridge as claimed in claim 4, further comprising a plurality of address filters associated respectively with said local area networks, each of the address filters allowing packets from the associated local area network to be forwarded to said destination local area network if said packets are destined to local area networks other than the associated local area network.

7. A bridge for interconnecting a plurality of local area networks, comprising:

header detector to detect a packet header contained in a packet transmitted from a first local area network to a second local area network;

registration table for storing information representing packets which are to be protected from interference by other packets;

comparator for comparing the packet header detected by said header detector with the information stored in the registration table to detect a match or mismatch;

gate circuit responsive to a match detected by said comparator for preventing said other packets from being forwarded to said second local area network and responsive to a mismatch detected by said comparator for allowing said other packets to be forwarded to said second local area network; and

timer responsive to a match detected by said comparator for preventing said other packets from being forwarded to said second local area network for a specified period of time.

8. A bridge as claimed in claim 7, wherein the information stored in said registration table represents a packet header identifying multimedia application software.

9. A bridge as claimed in claim 7, further comprising address filter for allowing packets from said first local area network to be forwarded to said second local area network if said packets are destined to local area networks other than said first local area network.

* * * * *

US006542491B1

(12) **United States Patent**
Tari et al.

(10) **Patent No.: US 6,542,491 B1**
(45) **Date of Patent: Apr. 1, 2003**

(54) **WIRELESS SERVER, SYSTEM AND METHOD**

(75) Inventors: **Kazuyoshi Tari**, Omiya (JP); **Tumoru Nagira**, Omiya (JP); **Hiroyuki Unoki**, Omiya (JP); **Kenichi Murayama**, Omiya (JP)

(73) Assignee: **Mitsubishi Materials Corporation**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/397,699**

(22) Filed: **Sep. 16, 1999**

(30) **Foreign Application Priority Data**

Sep. 16, 1998 (JP) 10-262099
Sep. 30, 1998 (JP) 10-294592
Oct. 29, 1998 (JP) 10-309228
Oct. 29, 1998 (JP) 10-309231
Dec. 18, 1998 (JP) 10-361659

(51) **Int. Cl.**[7] **H04Q 7/24**; H04Q 7/20; G06F 15/16

(52) **U.S. Cl.** **370/338**; 370/356; 370/401; 455/433; 455/445; 709/203

(58) **Field of Search** 370/328, 329, 370/331, 338, 351, 352, 402, 389, 390, 432, 401, 353, 354, 356, 358; 709/201, 202, 203; 455/433, 445, 450

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,572,528 A * 11/1996 Shuen 370/402
5,619,552 A * 4/1997 Karppanen et al. 455/433
5,745,884 A * 4/1998 Carnegie et al. 705/34
5,825,759 A * 10/1998 Liu 370/331
5,862,345 A * 1/1999 Okanoue et al. 709/238
6,108,727 A * 8/2000 Boals et al. 710/68
6,281,790 B1 * 8/2001 Kimmel et al. 340/506

FOREIGN PATENT DOCUMENTS

EP 0 938 217 8/1999
JP 1-177232 (63-000477) 7/1989
JP 8-181713 7/1996
JP 11-055317 2/1999
JP 11-088433 3/1999
JP 11-308273 11/1999

* cited by examiner

Primary Examiner—Hassan Kizou
Assistant Examiner—Afsar M. Qureshi
(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland, Maier & Neustadt, P.C.

(57) **ABSTRACT**

A wireless server system and method for communicating between a user terminal and Internet a wirelessly. It is based on a user terminal having a fixed terminal and a terminal unit so that an Internet connection can be made by way of the terminal unit to an appropriate wireless server. The system has at least one wireless server connected to Internet; and a plurality of wireless station devices connected to the wireless server, and the system communicates wirelessly with the terminal unit of the user terminal; wherein one wireless server within a district of communication range of the wireless station devices is designated as a home server for the terminal unit, and the fixed terminal receives data sent wirelessly from Internet by way of the terminal unit.

29 Claims, 28 Drawing Sheets

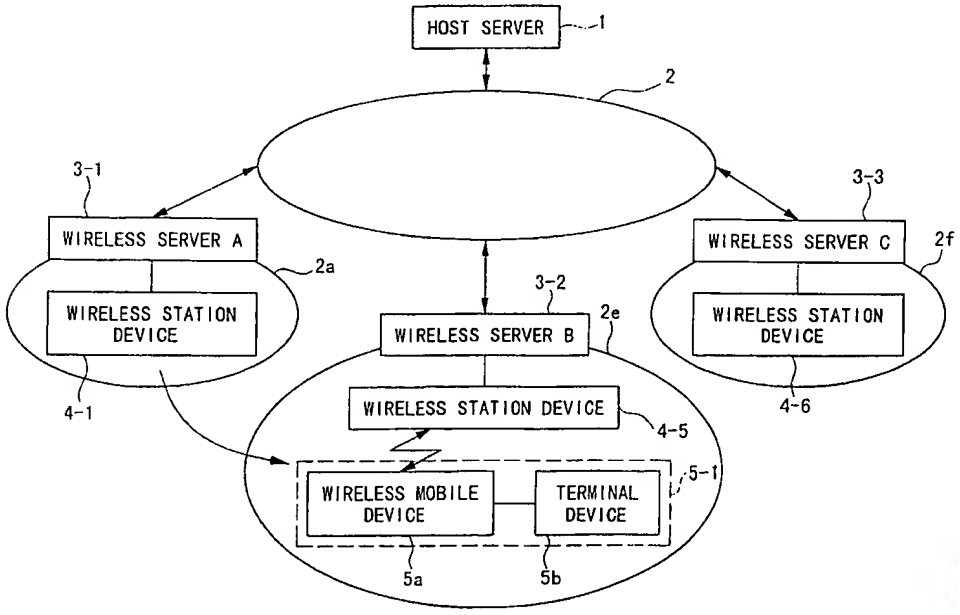


FIG. 1

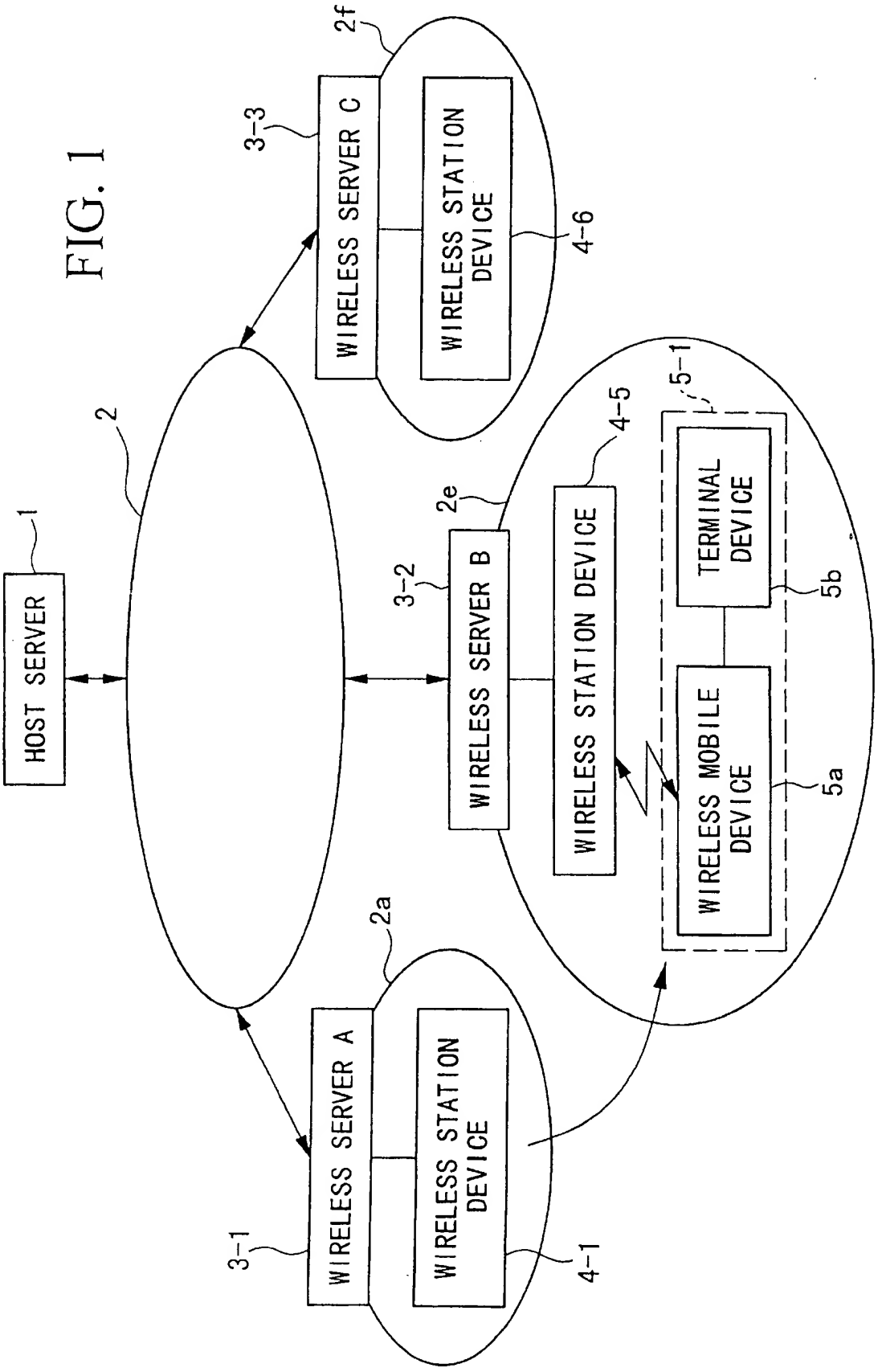

HOST SERVER
1
2
WIRELESS SERVER A
3-1
2a
WIRELESS STATION DEVICE
4-1
WIRELESS SERVER B
3-2
2e
WIRELESS STATION DEVICE
4-5
WIRELESS MOBILE DEVICE
5a
TERMINAL DEVICE
5b
5-1
WIRELESS SERVER C
3-3
2f
WIRELESS STATION DEVICE
4-6

FIG. 2

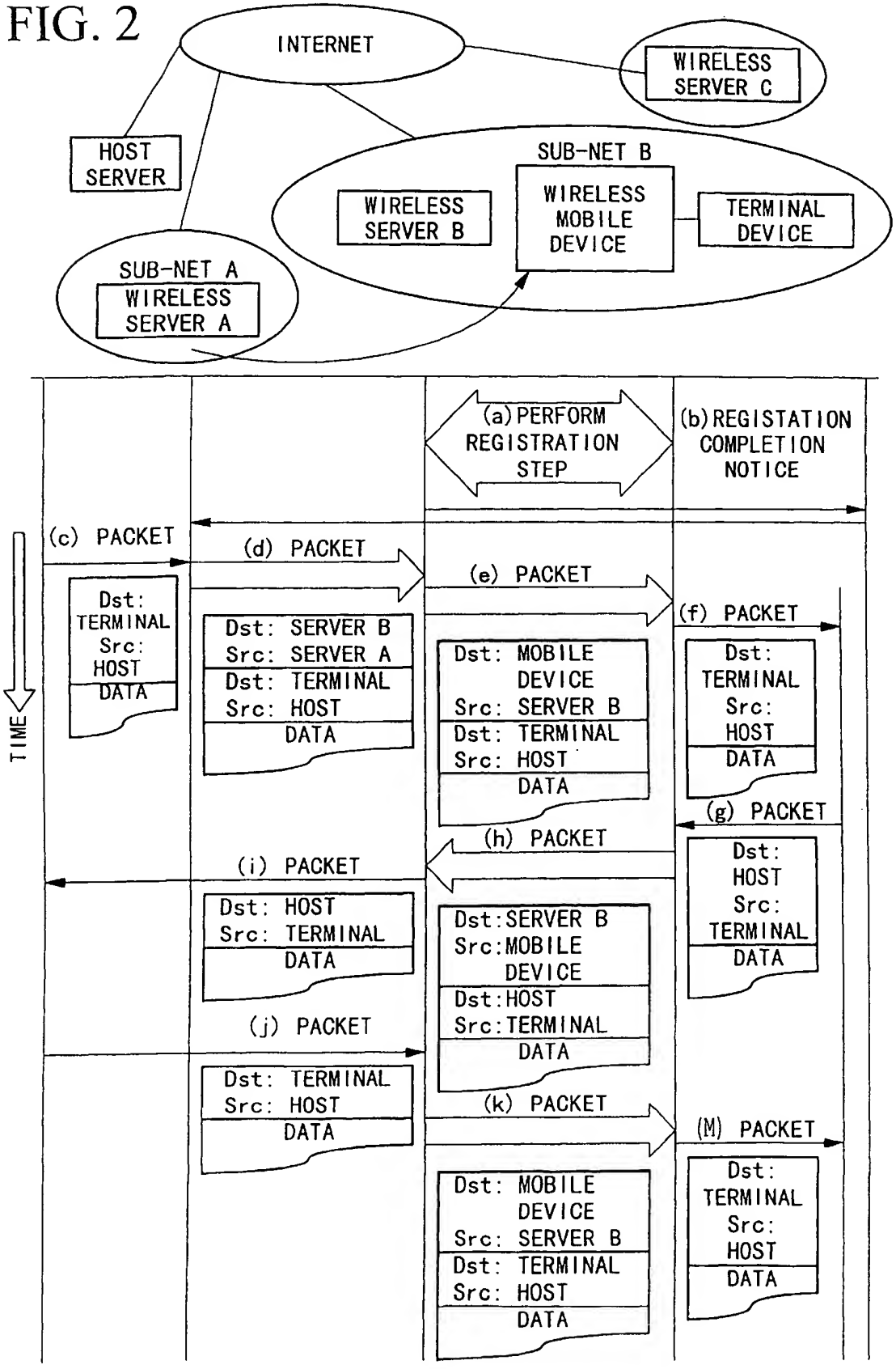

INTERNET
WIRELESS SERVER C
HOST SERVER
SUB-NET B
WIRELESS SERVER B
WIRELESS MOBILE DEVICE
TERMINAL DEVICE
SUB-NET A
WIRELESS SERVER A
(a) PERFORM REGISTRATION STEP
(b) REGISTATION COMPLETION NOTICE
TIME
(c) PACKET
(d) PACKET
(e) PACKET
(f) PACKET
(g) PACKET
(h) PACKET
(i) PACKET
(j) PACKET
(k) PACKET
(M) PACKET
Dst: TERMINAL Src: HOST DATA
Dst: SERVER B Src: SERVER A Dst: TERMINAL Src: HOST DATA
Dst: MOBILE DEVICE Src: SERVER B Dst: TERMINAL Src: HOST DATA
Dst: TERMINAL Src: HOST DATA
Dst: HOST Src: TERMINAL DATA
Dst: SERVER B Src: MOBILE DEVICE Dst: HOST Src: TERMINAL DATA
Dst: HOST Src: TERMINAL DATA
Dst: TERMINAL Src: HOST DATA
Dst: MOBILE DEVICE Src: SERVER B Dst: TERMINAL Src: HOST DATA
Dst: TERMINAL Src: HOST DATA

FIG. 3

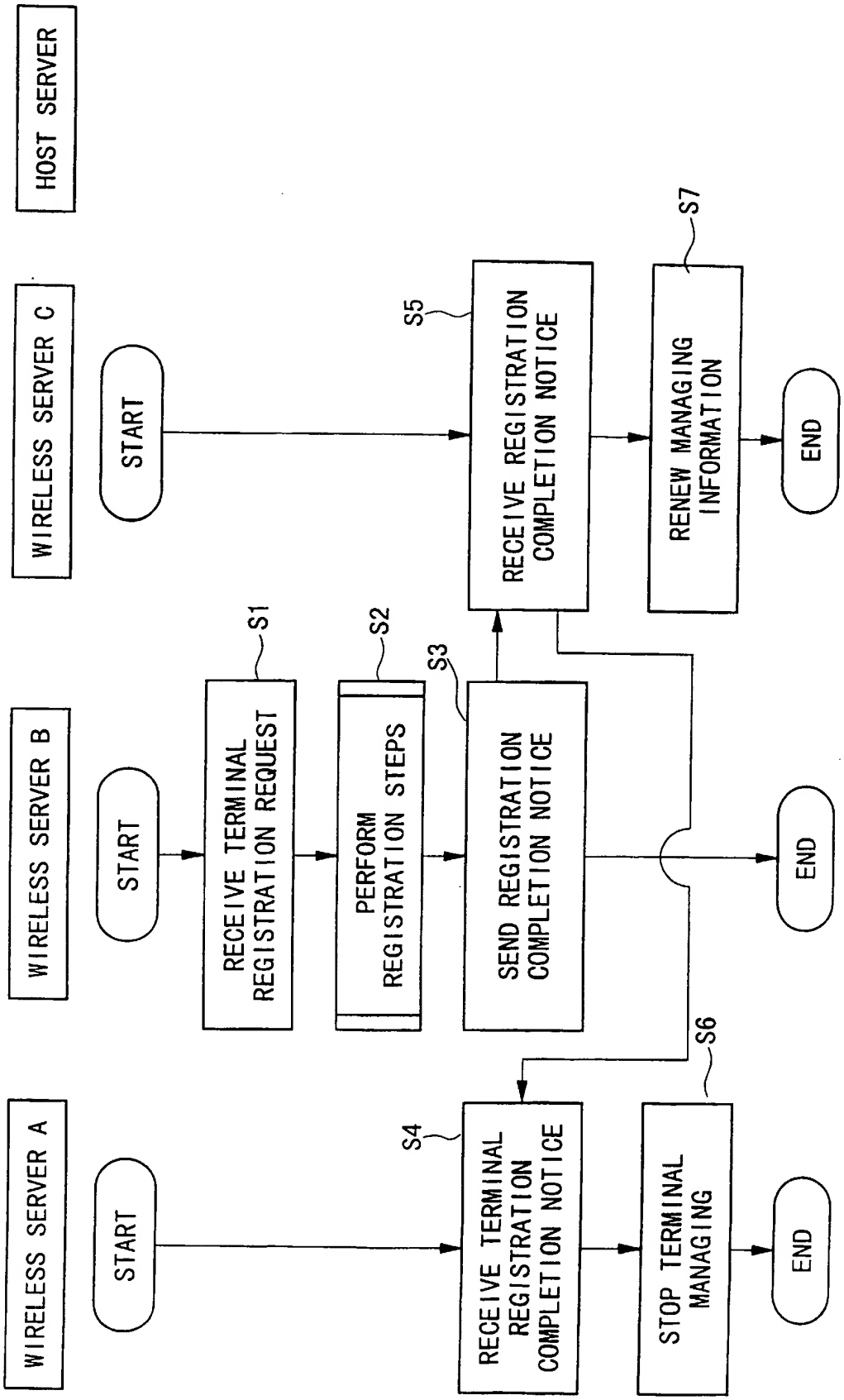

WIRELESS SERVER A
WIRELESS SERVER B
WIRELESS SERVER C
HOST SERVER
START
START
START
RECEIVE TERMINAL REGISTRATION REQUEST
S1
PERFORM REGISTRATION STEPS
S2
SEND REGISTRATION COMPLETION NOTICE
S3
RECEIVE REGISTRATION COMPLETION NOTICE
S5
RENEW MANAGING INFORMATION
S7
RECEIVE TERMINAL REGISTRATION COMPLETION NOTICE
S4
STOP TERMINAL MANAGING
S6
END
END
END

FIG. 4

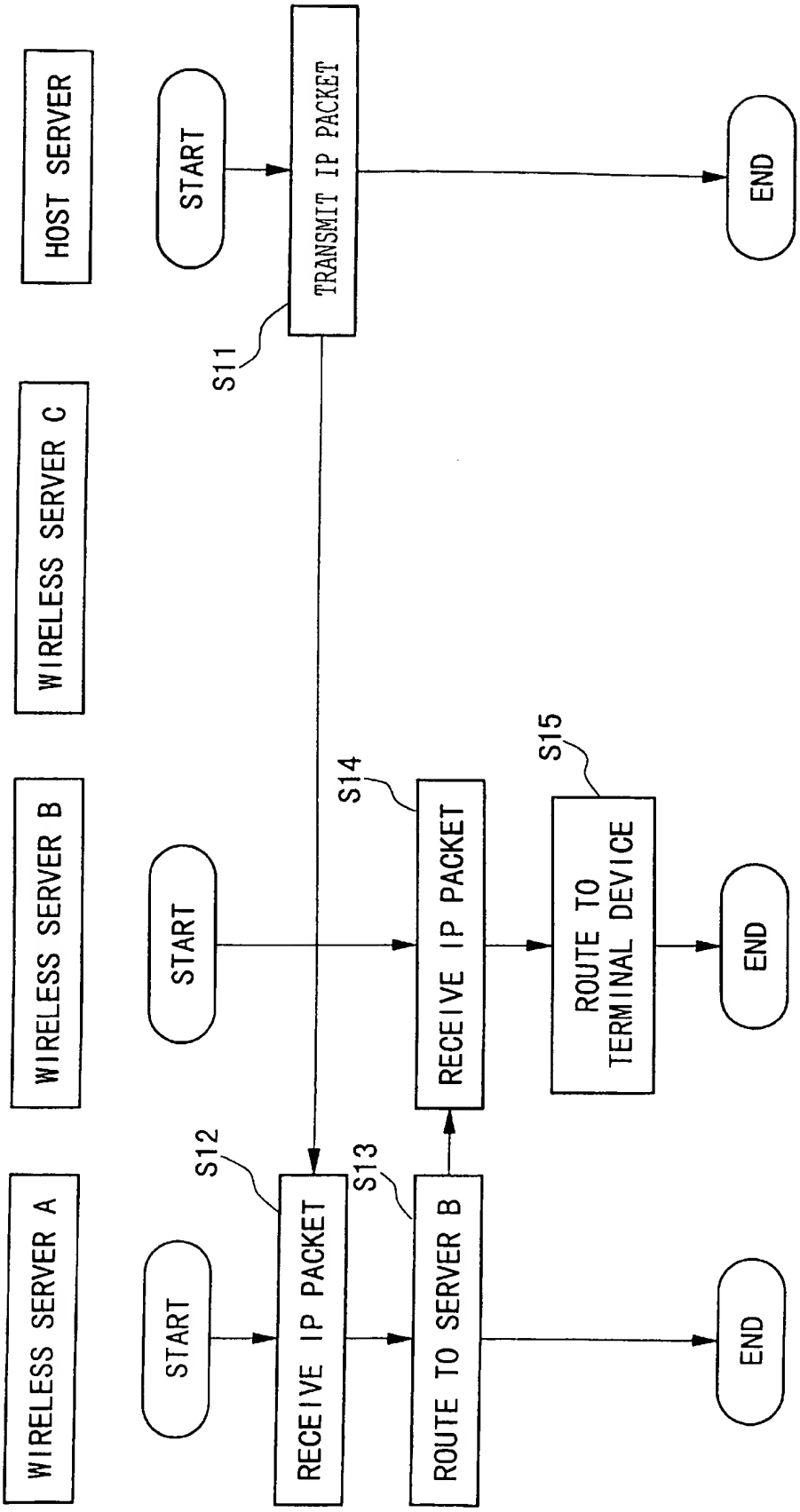

HOST SERVER
WIRELESS SERVER C
WIRELESS SERVER B
WIRELESS SERVER A
START
TRANSMIT IP PACKET
END
S11
START
RECEIVE IP PACKET
S14
ROUTE TO TERMINAL DEVICE
S15
END
START
RECEIVE IP PACKET
S12
ROUTE TO SERVER B
S13
END

FIG. 5

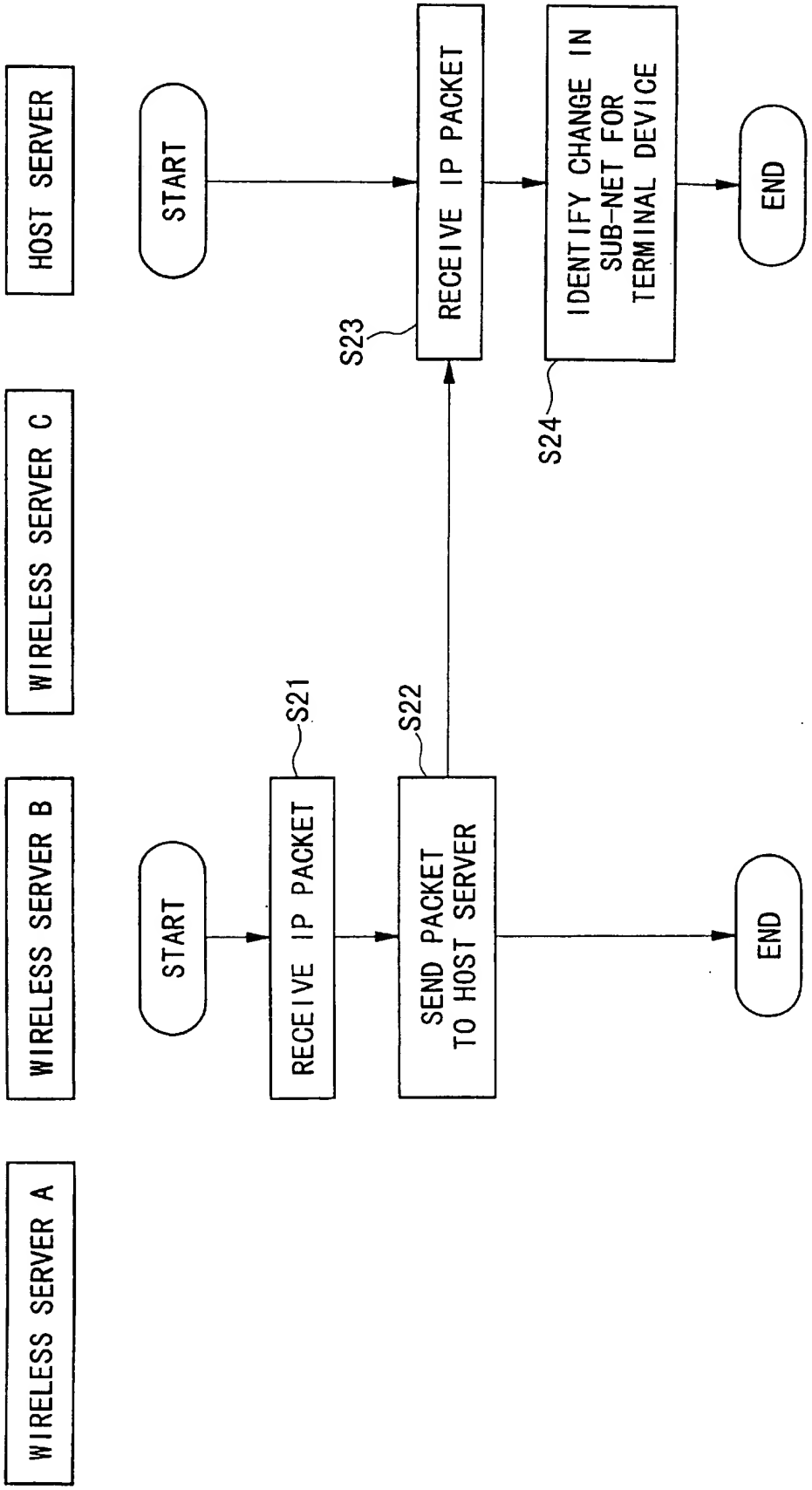

WIRELESS SERVER A
WIRELESS SERVER B
WIRELESS SERVER C
HOST SERVER
START
RECEIVE IP PACKET
S21
SEND PACKET TO HOST SERVER
S22
END
START
RECEIVE IP PACKET
S23
IDENTIFY CHANGE IN SUB-NET FOR TERMINAL DEVICE
S24
END

FIG. 6

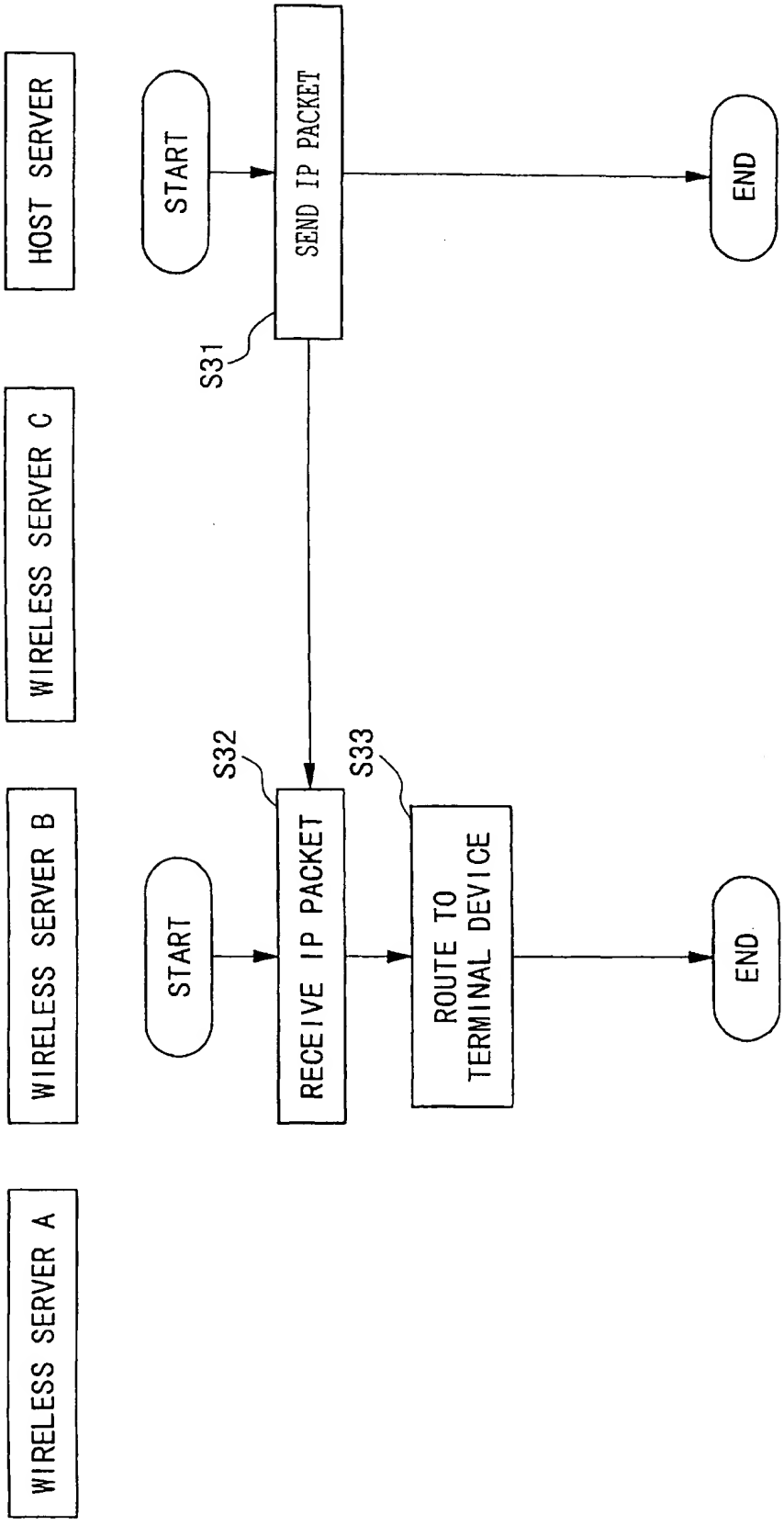

HOST SERVER
WIRELESS SERVER C
WIRELESS SERVER B
WIRELESS SERVER A
START
SEND IP PACKET
END
S31
S32
S33
START
RECEIVE IP PACKET
ROUTE TO TERMINAL DEVICE
END

FIG. 7

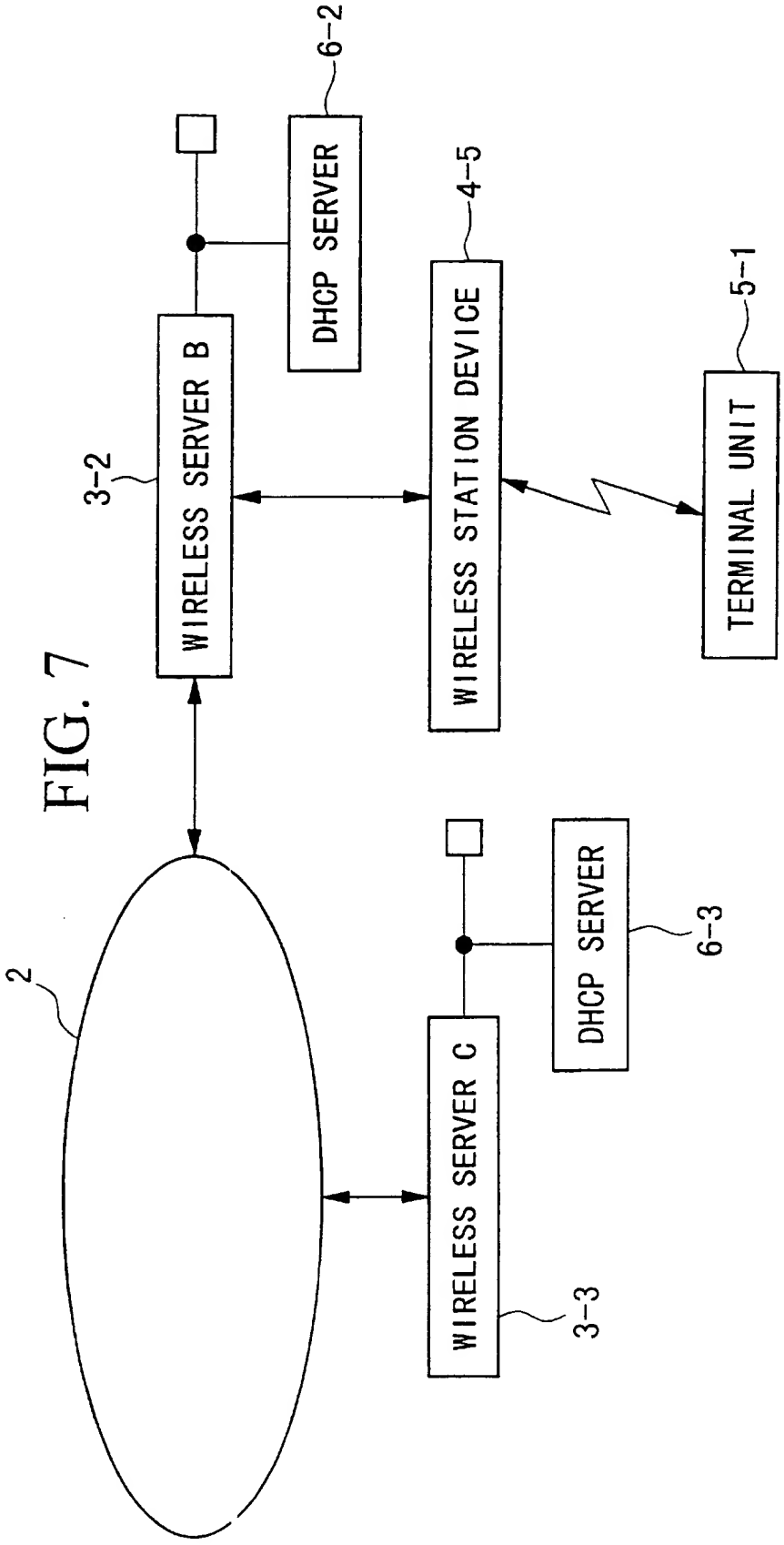

6-2
DHCP SERVER
4-5
WIRELESS STATION DEVICE
5-1
TERMINAL UNIT
3-2
WIRELESS SERVER B
2
6-3
DHCP SERVER
WIRELESS SERVER C
3-3

FIG. 8

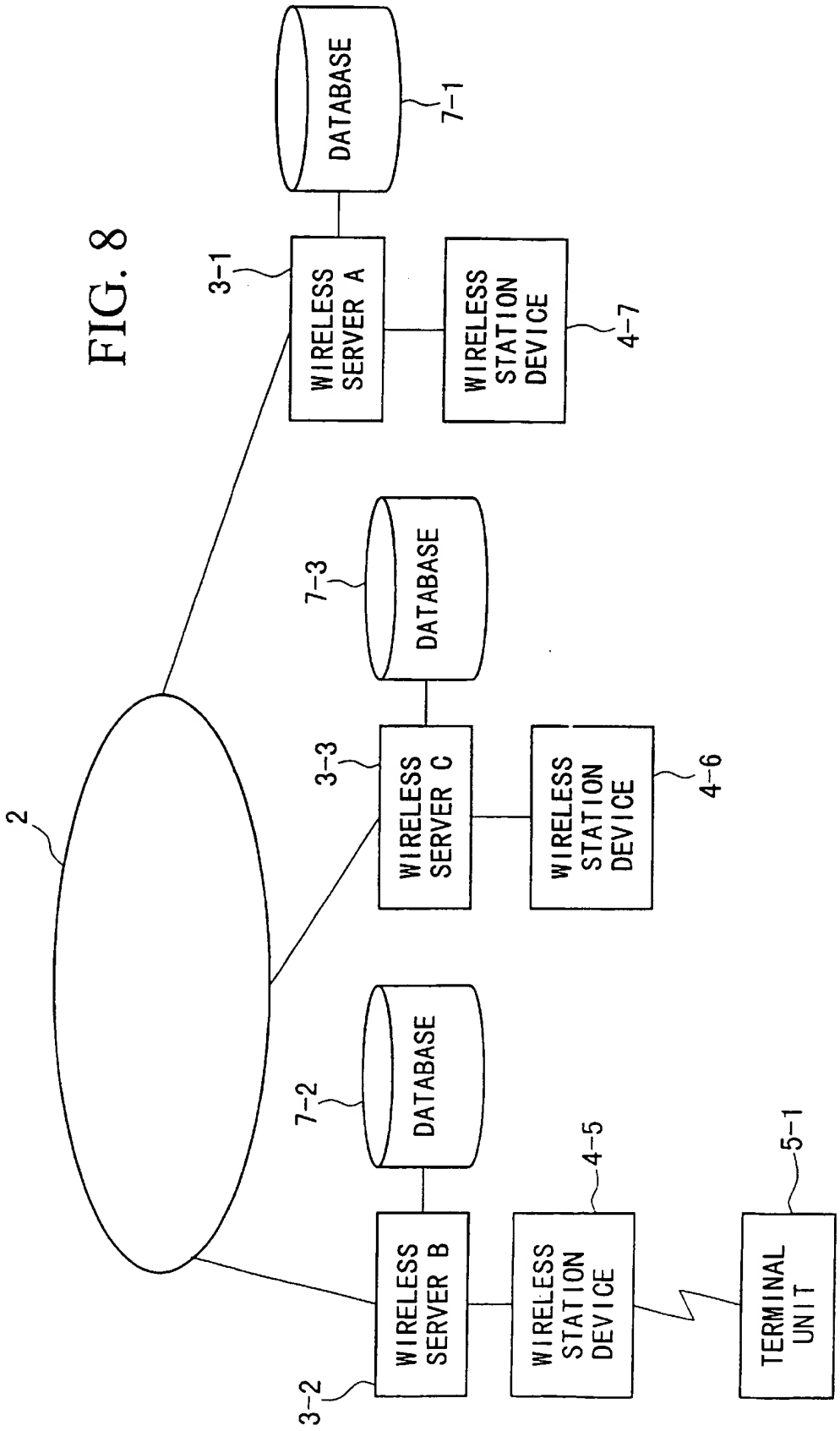

DATABASE
7-1
3-1
WIRELESS SERVER A
WIRELESS STATION DEVICE
4-7
7-3
DATABASE
3-3
WIRELESS SERVER C
WIRELESS STATION DEVICE
4-6
2
7-2
DATABASE
4-5
5-1
WIRELESS SERVER B
WIRELESS STATION DEVICE
TERMINAL UNIT
3-2

FIG. 9

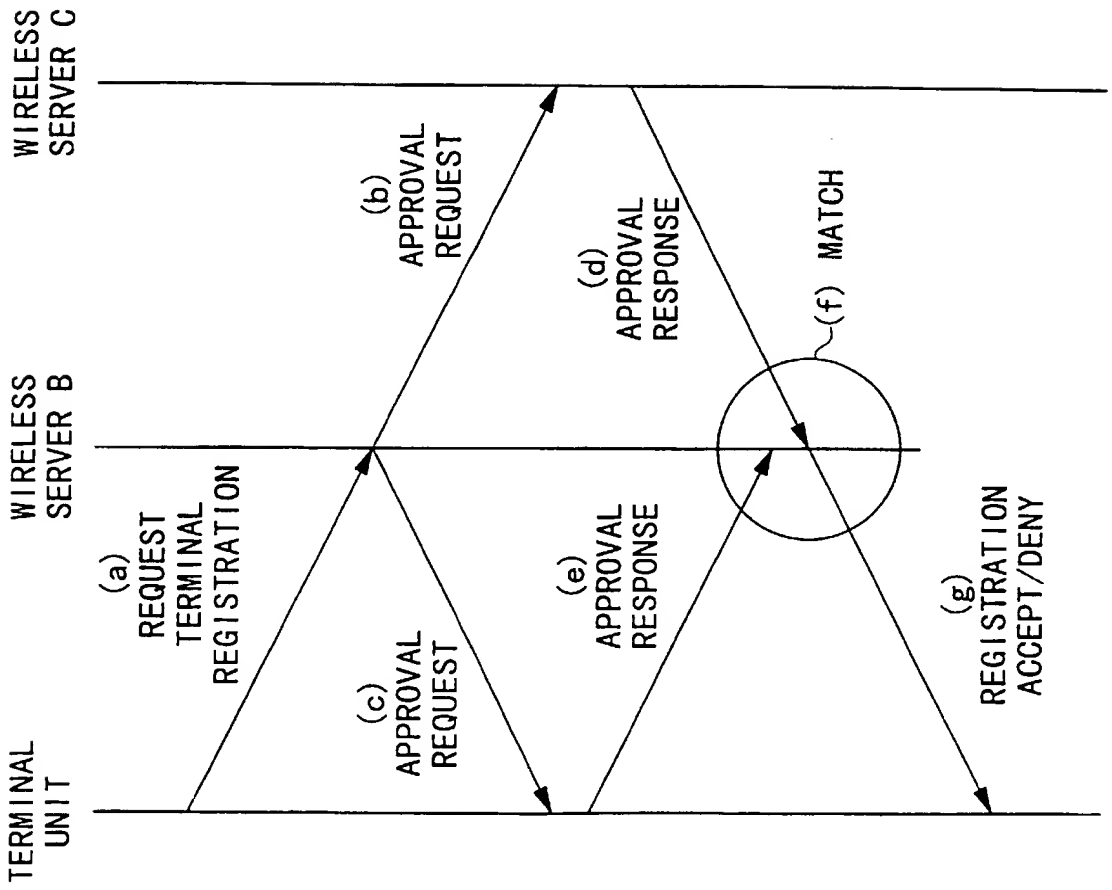

TERMINAL UNIT
WIRELESS SERVER B
WIRELESS SERVER C
(a) REQUEST TERMINAL REGISTRATION
(b) APPROVAL REQUEST
(c) APPROVAL REQUEST
(d) APPROVAL RESPONSE
(e) APPROVAL RESPONSE
(f) MATCH
(g) REGISTRATION ACCEPT/DENY

FIG. 10

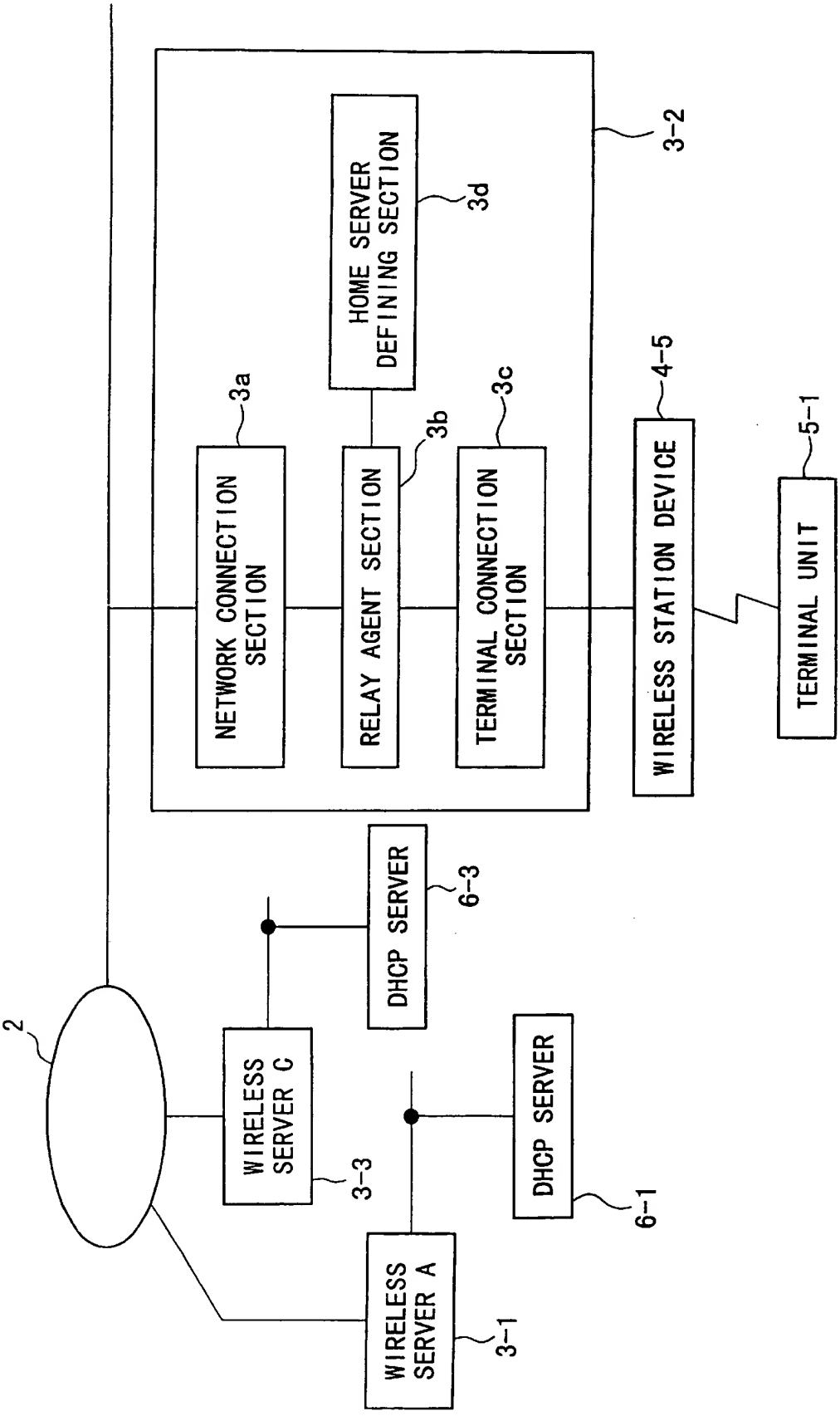

2
WIRELESS SERVER A
3-1
WIRELESS SERVER C
3-3
DHCP SERVER
6-1
DHCP SERVER
6-3
3-2
NETWORK CONNECTION SECTION
3a
RELAY AGENT SECTION
3b
TERMINAL CONNECTION SECTION
3c
HOME SERVER DEFINING SECTION
3d
WIRELESS STATION DEVICE
4-5
TERMINAL UNIT
5-1

FIG. 11

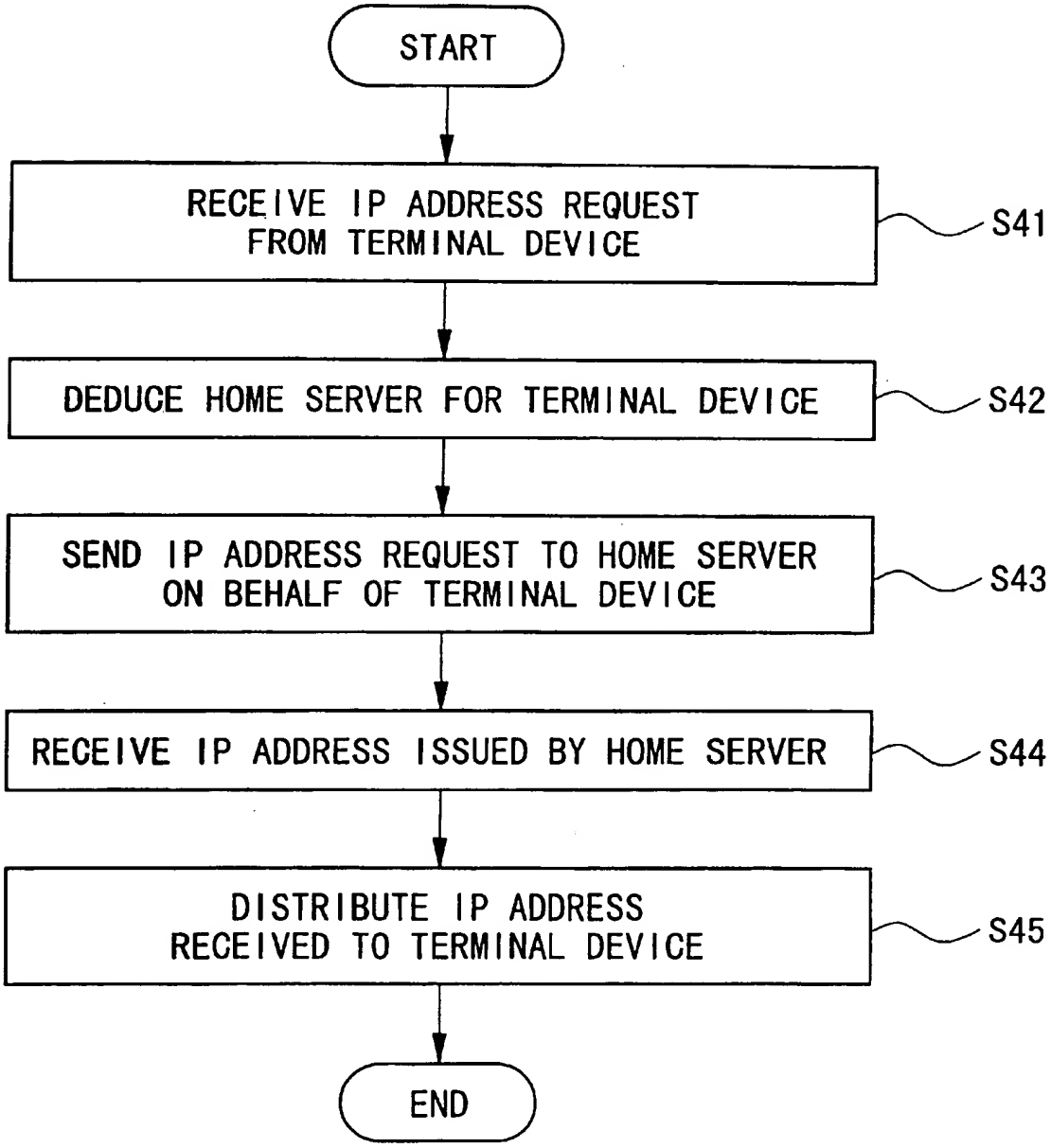
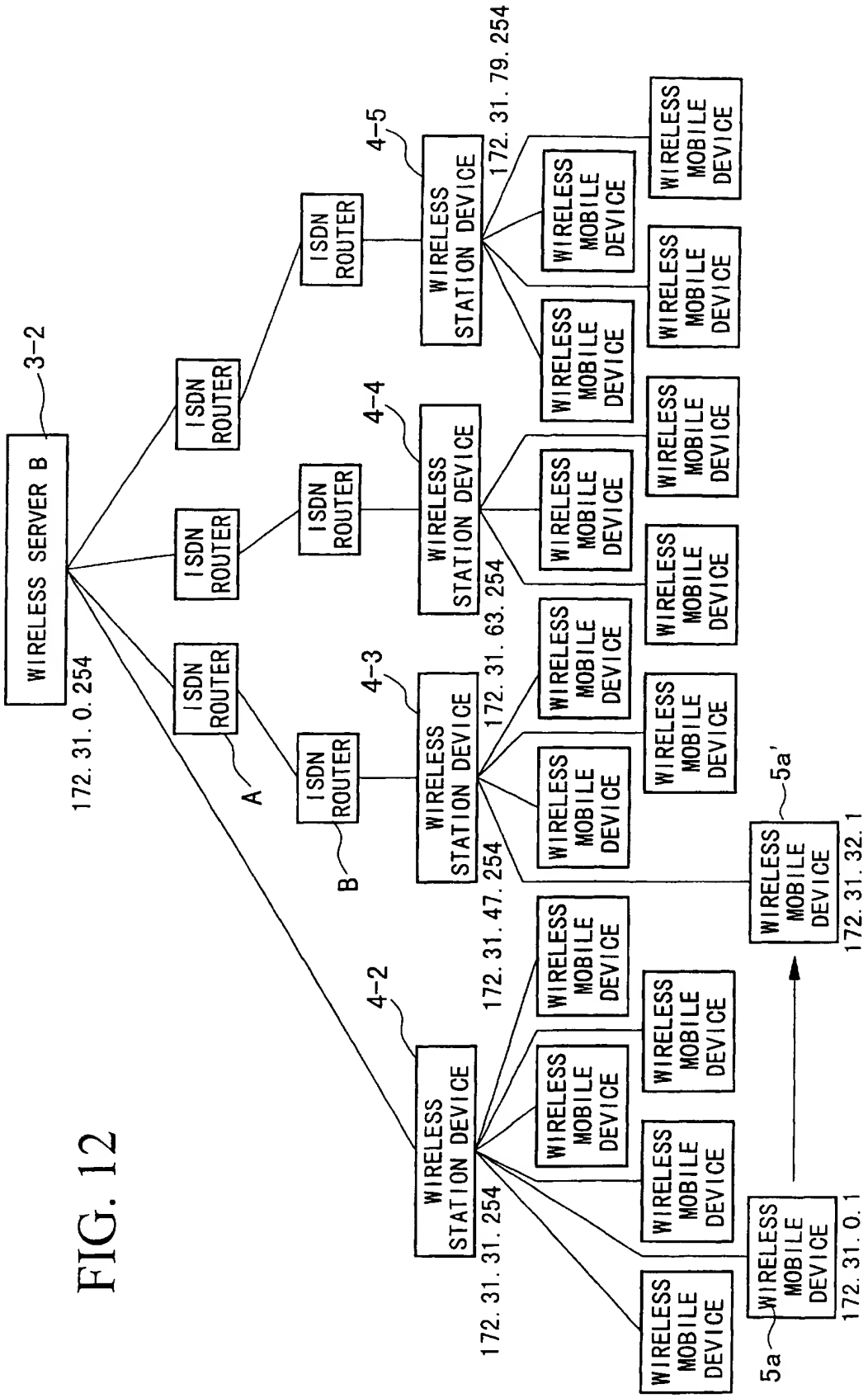

START
RECEIVE IP ADDRESS REQUEST FROM TERMINAL DEVICE
S41
DEDUCE HOME SERVER FOR TERMINAL DEVICE
S42
SEND IP ADDRESS REQUEST TO HOME SERVER ON BEHALF OF TERMINAL DEVICE
S43
RECEIVE IP ADDRESS ISSUED BY HOME SERVER
S44
DISTRIBUTE IP ADDRESS RECEIVED TO TERMINAL DEVICE
S45
END

FIG. 12


WIRELESS SERVER B
3-2
172. 31. 0. 254
ISDN ROUTER
ISDN ROUTER
ISDN ROUTER
ISDN ROUTER
ISDN ROUTER
A
B
4-2
4-3
4-4
4-5
WIRELESS STATION DEVICE
172. 31. 31. 254
172. 31. 47. 254
172. 31. 63. 254
172. 31. 79. 254
WIRELESS MOBILE DEVICE
5a
5a'
172. 31. 0. 1
172. 31. 32. 1

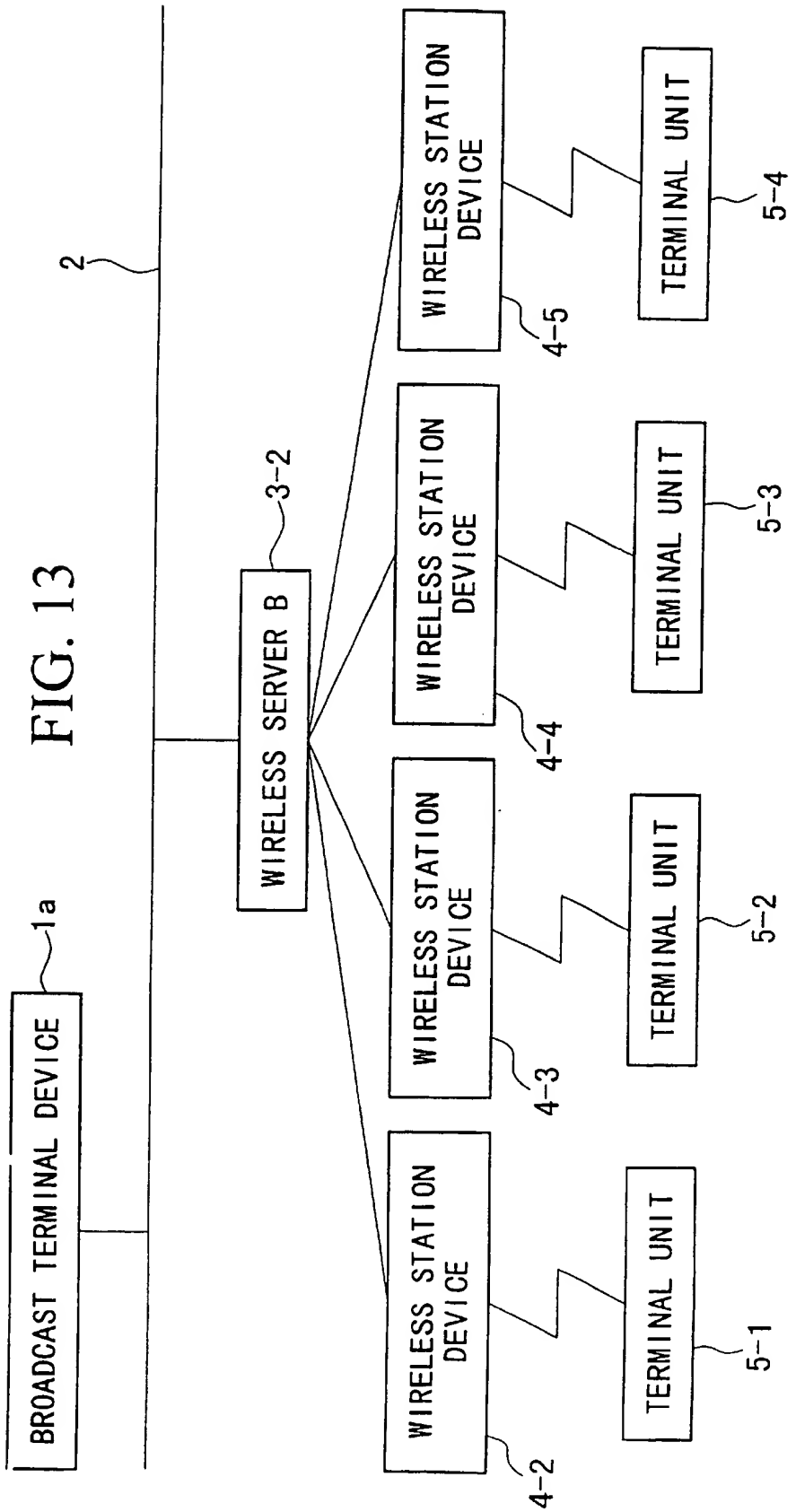

BROADCAST TERMINAL DEVICE
1a
2
WIRELESS SERVER B
3-2
WIRELESS STATION DEVICE
4-2
WIRELESS STATION DEVICE
4-3
WIRELESS STATION DEVICE
4-4
WIRELESS STATION DEVICE
4-5
TERMINAL UNIT
5-1
TERMINAL UNIT
5-2
TERMINAL UNIT
5-3
TERMINAL UNIT
5-4

FIG. 13

FIG. 14

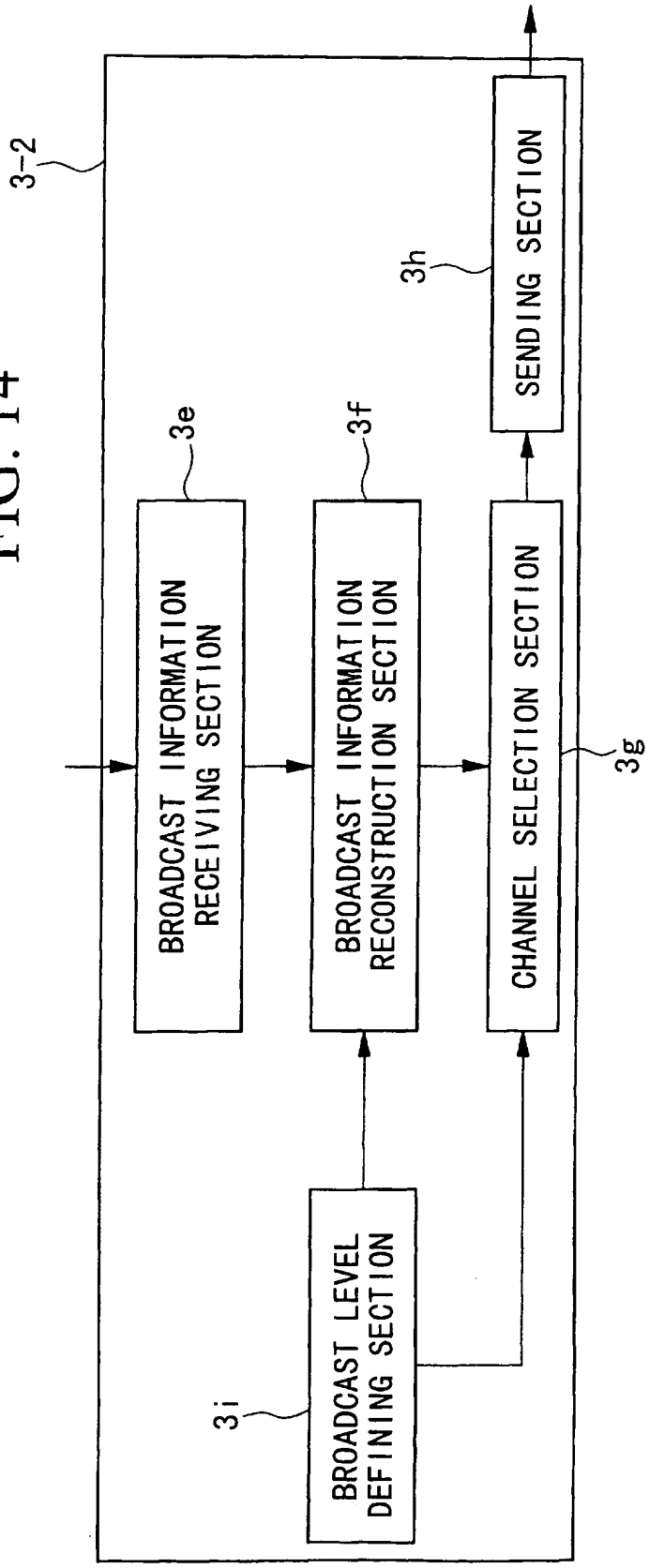

3-2
BROADCAST INFORMATION RECEIVING SECTION
3e
BROADCAST INFORMATION RECONSTRUCTION SECTION
3f
CHANNEL SELECTION SECTION
3g
SENDING SECTION
3h
BROADCAST LEVEL DEFINING SECTION
3i

FIG. 15

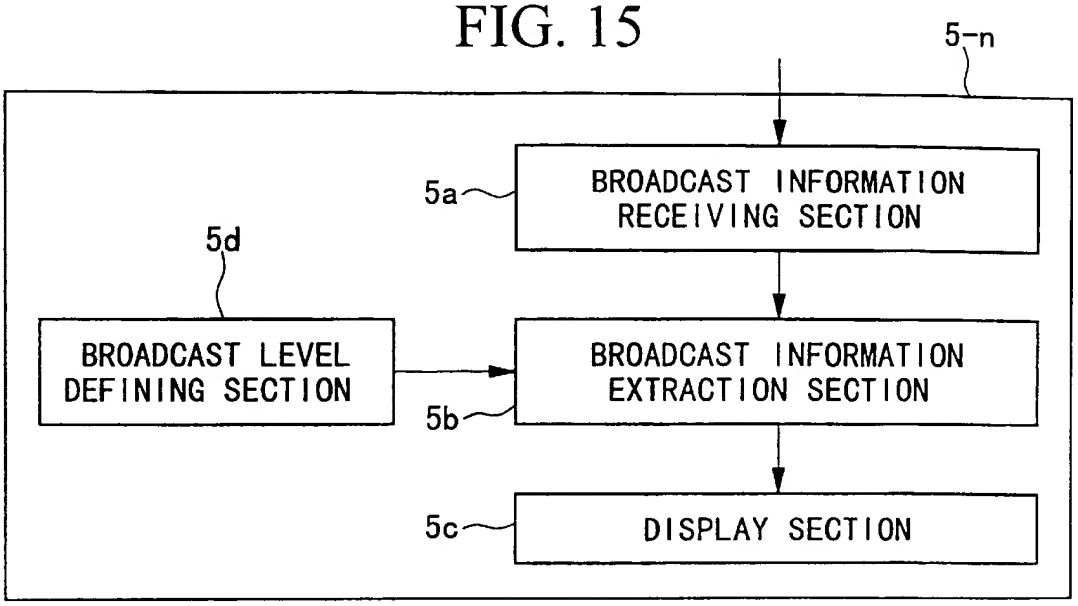

5-n
5a
BROADCAST INFORMATION RECEIVING SECTION
5d
BROADCAST LEVEL DEFINING SECTION
BROADCAST INFORMATION EXTRACTION SECTION
5b
5c
DISPLAY SECTION

FIG. 16

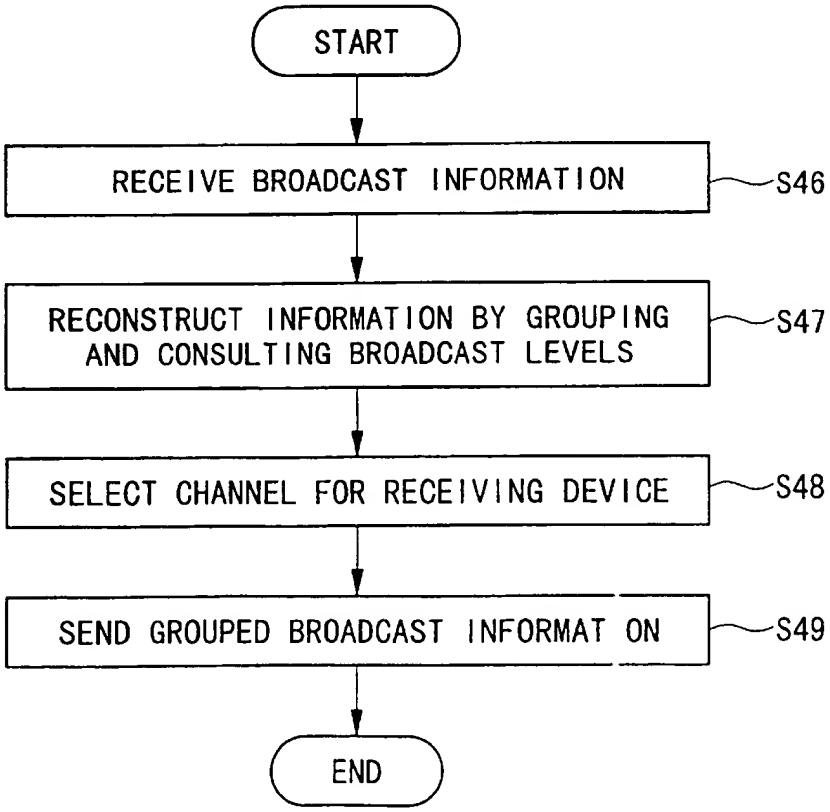

START
RECEIVE BROADCAST INFORMATION
S46
RECONSTRUCT INFORMATION BY GROUPING AND CONSULTING BROADCAST LEVELS
S47
SELECT CHANNEL FOR RECEIVING DEVICE
S48
SEND GROUPED BROADCAST INFORMAT ON
S49
END

FIG. 17

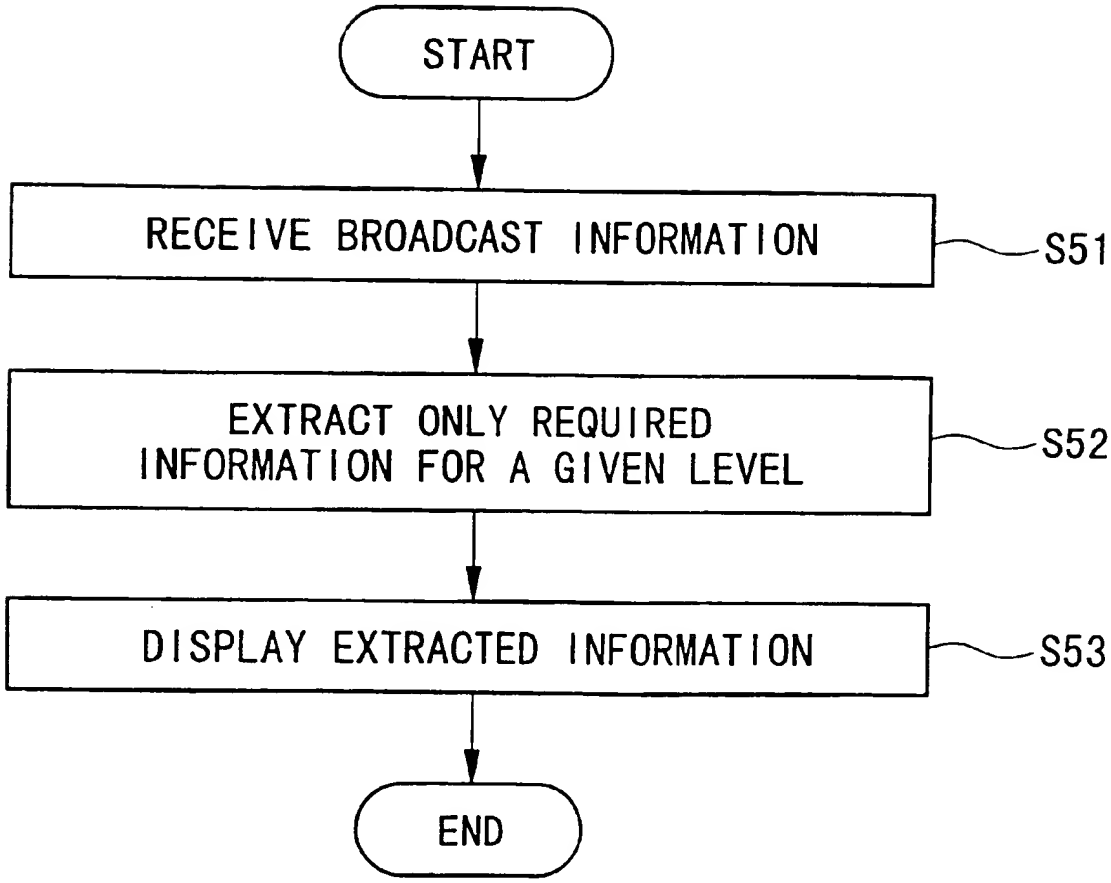

START
RECEIVE BROADCAST INFORMATION
S51
EXTRACT ONLY REQUIRED INFORMATION FOR A GIVEN LEVEL
S52
DISPLAY EXTRACTED INFORMATION
S53
END

FIG. 18

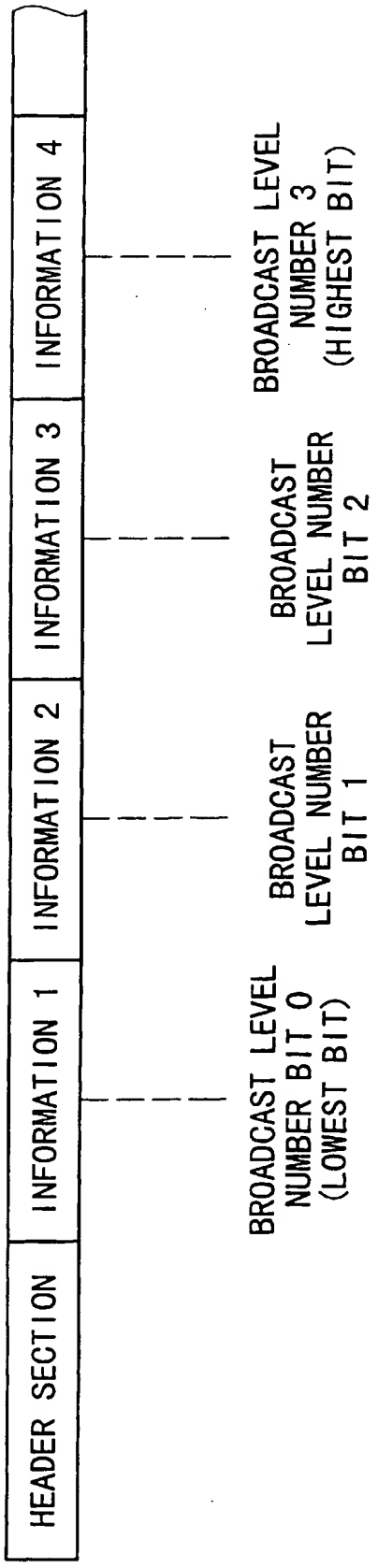

HEADER SECTION
INFORMATION 1
INFORMATION 2
INFORMATION 3
INFORMATION 4
BROADCAST LEVEL NUMBER BIT 0 (LOWEST BIT)
BROADCAST LEVEL NUMBER BIT 1
BROADCAST LEVEL NUMBER BIT 2
BROADCAST LEVEL NUMBER 3 (HIGHEST BIT)

FIG. 19

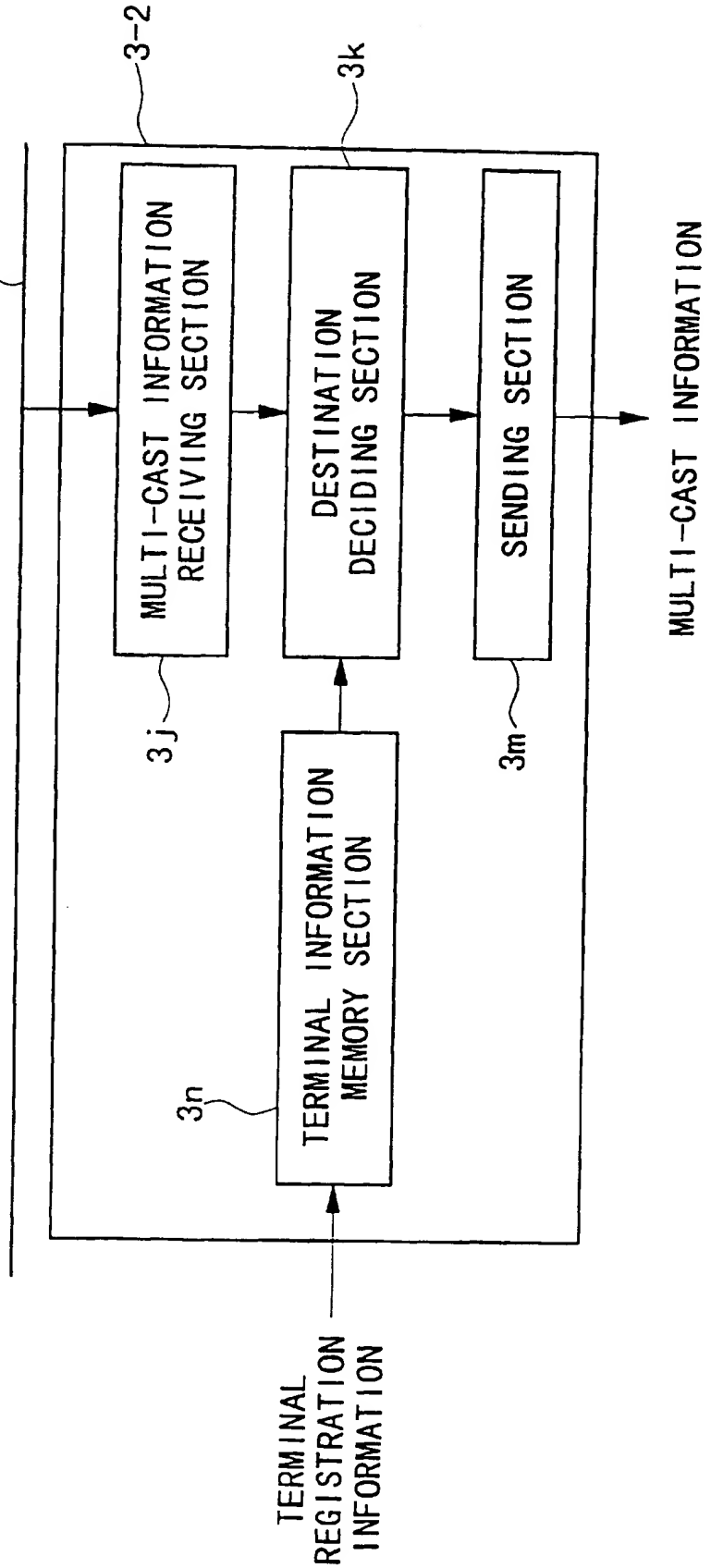

2
3-2
3k
MULTI-CAST INFORMATION RECEIVING SECTION
DESTINATION DECIDING SECTION
SENDING SECTION
MULTI-CAST INFORMATION
3j
3m
3n
TERMINAL INFORMATION MEMORY SECTION
TERMINAL REGISTRATION INFORMATION

FIG. 20

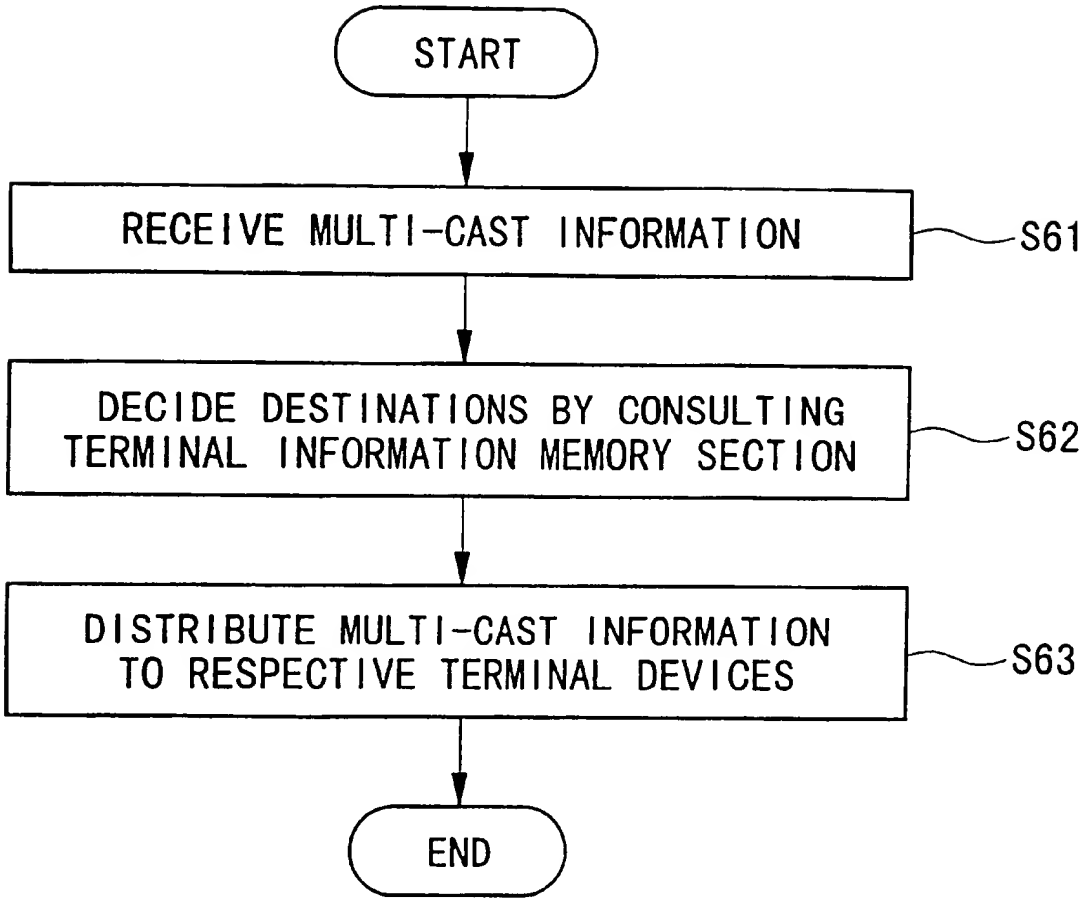

START
RECEIVE MULTI-CAST INFORMATION
S61
DECIDE DESTINATIONS BY CONSULTING TERMINAL INFORMATION MEMORY SECTION
S62
DISTRIBUTE MULTI-CAST INFORMATION TO RESPECTIVE TERMINAL DEVICES
S63
END

FIG. 21

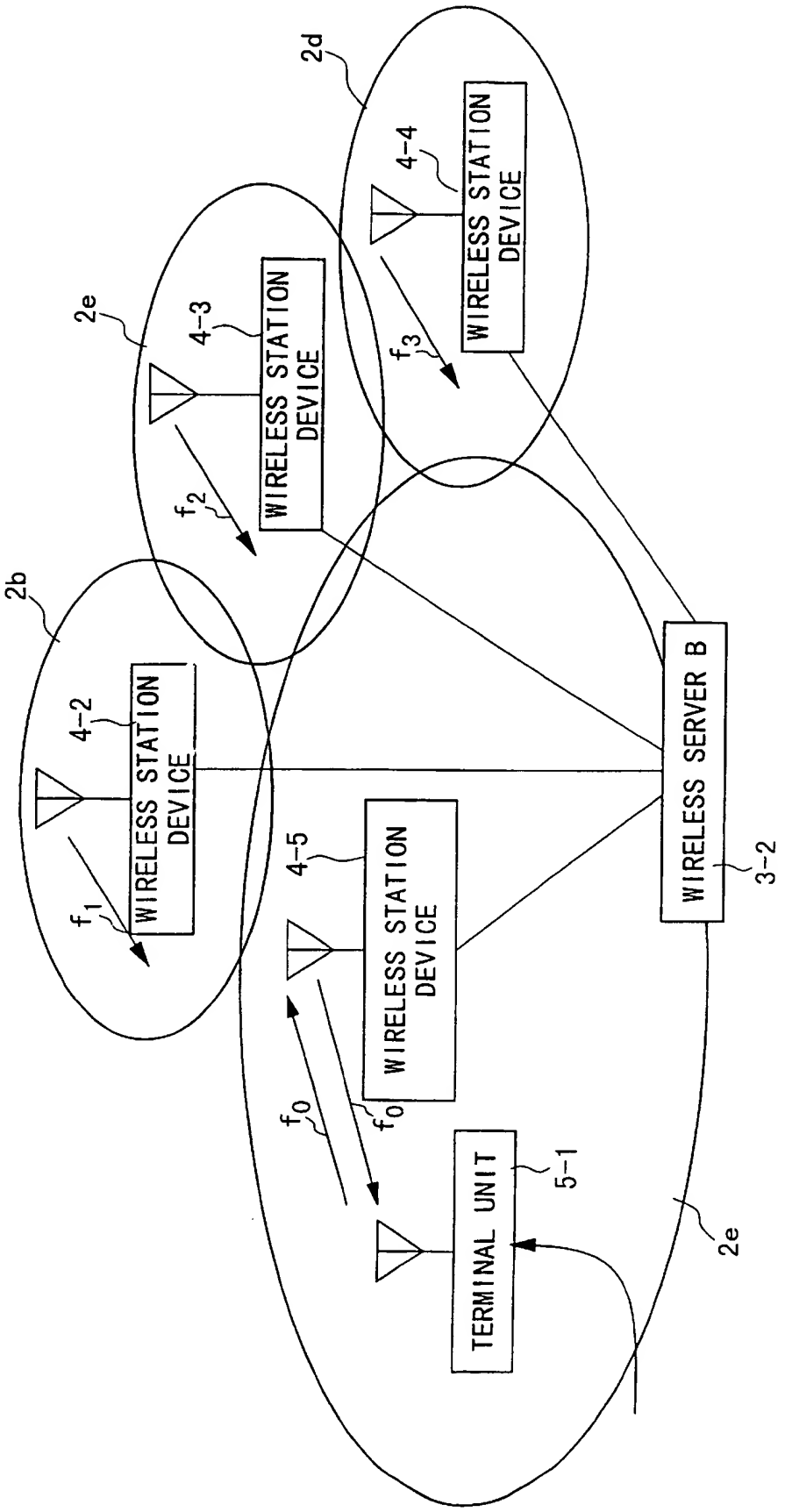

2d
4-4
WIRELESS STATION DEVICE
f_3
2e
4-3
WIRELESS STATION DEVICE
f_2
2b
4-2
WIRELESS STATION DEVICE
f_1
4-5
WIRELESS STATION DEVICE
f_0
f_0
WIRELESS SERVER B
3-2
TERMINAL UNIT
5-1
2e

FIG. 22

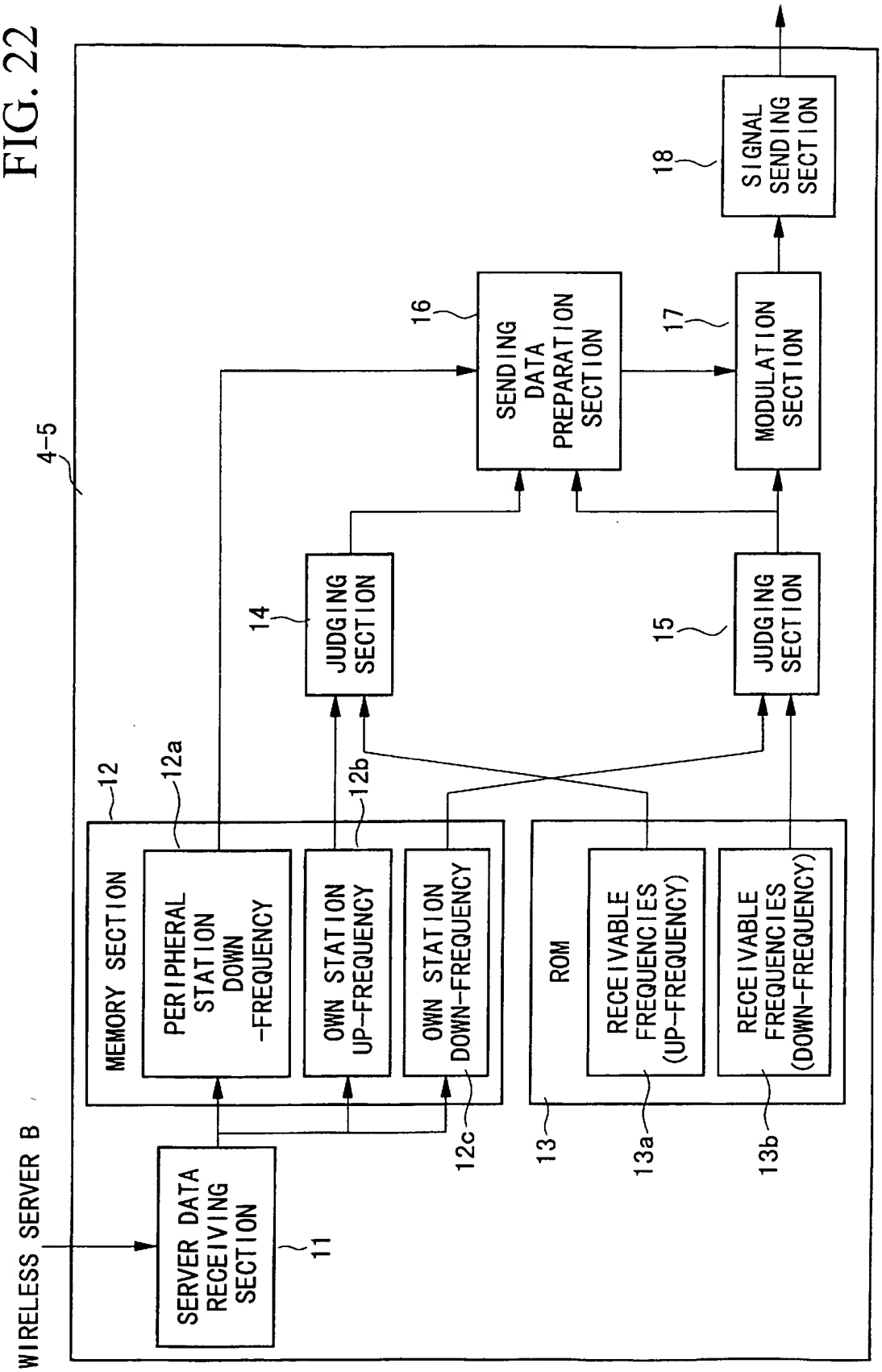

WIRELESS SERVER B
SERVER DATA RECEIVING SECTION
11
4-5
MEMORY SECTION
12
PERIPHERAL STATION DOWN -FREQUENCY
12a
OWN STATION UP-FREQUENCY
12b
OWN STATION DOWN-FREQUENCY
12c
ROM
13
RECEIVABLE FREQUENCIES (UP-FREQUENCY)
13a
RECEIVABLE FREQUENCIES (DOWN-FREQUENCY)
13b
JUDGING SECTION
14
JUDGING SECTION
15
SENDING DATA PREPARATION SECTION
16
MODULATION SECTION
17
SIGNAL SENDING SECTION
18

FIG. 23

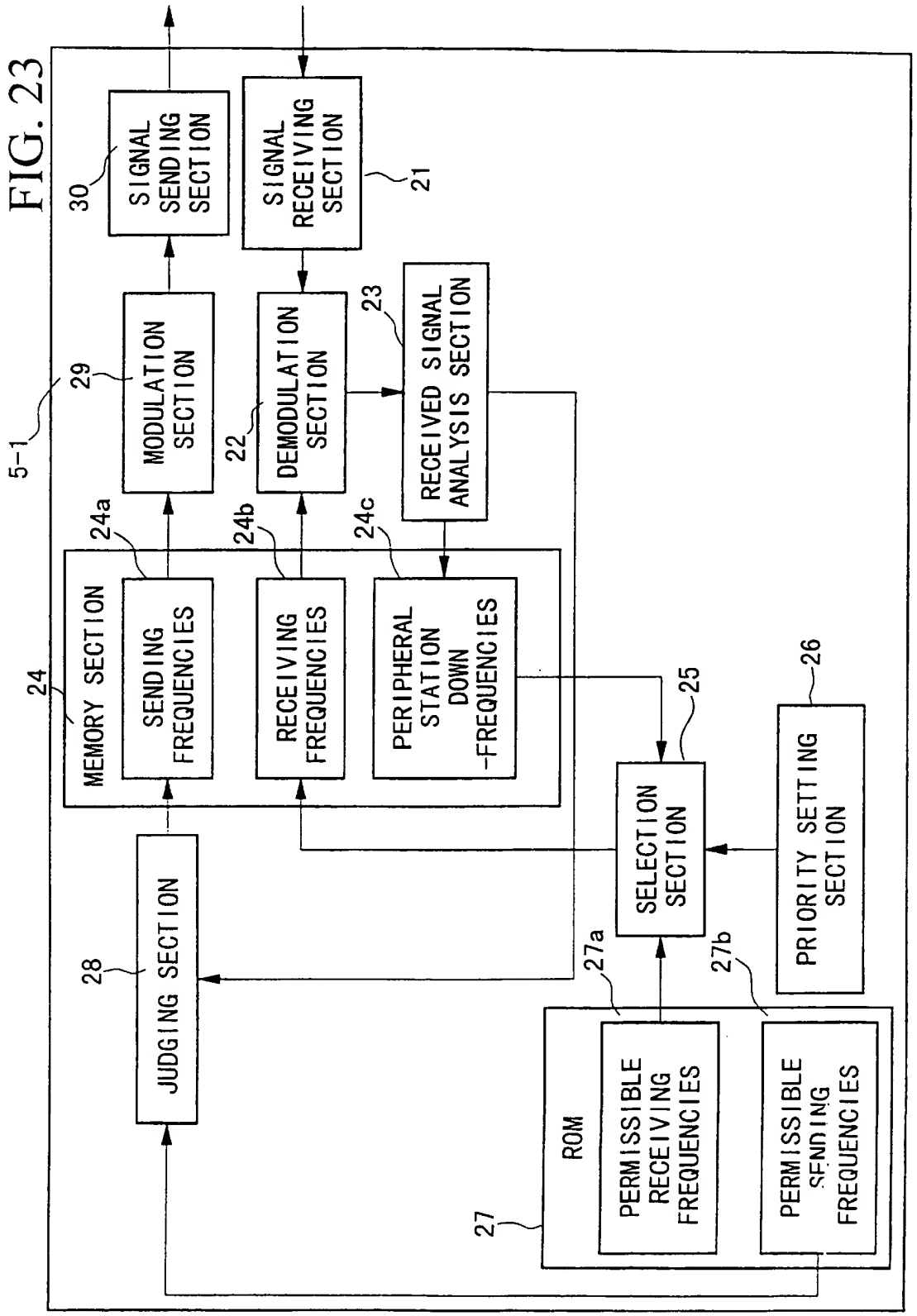

5-1
SIGNAL SENDING SECTION
30
SIGNAL RECEIVING SECTION
21
MODULATION SECTION
29
DEMODULATION SECTION
22
23
RECEIVED SIGNAL ANALYSIS SECTION
24a
24b
24c
MEMORY SECTION
24
SENDING FREQUENCIES
RECEIVING FREQUENCIES
PERIPHERAL STATION DOWN -FREQUENCIES
25
26
SELECTION SECTION
PRIORITY SETTING SECTION
JUDGING SECTION
28
27a
27b
ROM
27
PERMISSIBLE RECEIVING FREQUENCIES
PERMISSIBLE SENDING FREQUENCIES

FIG. 24

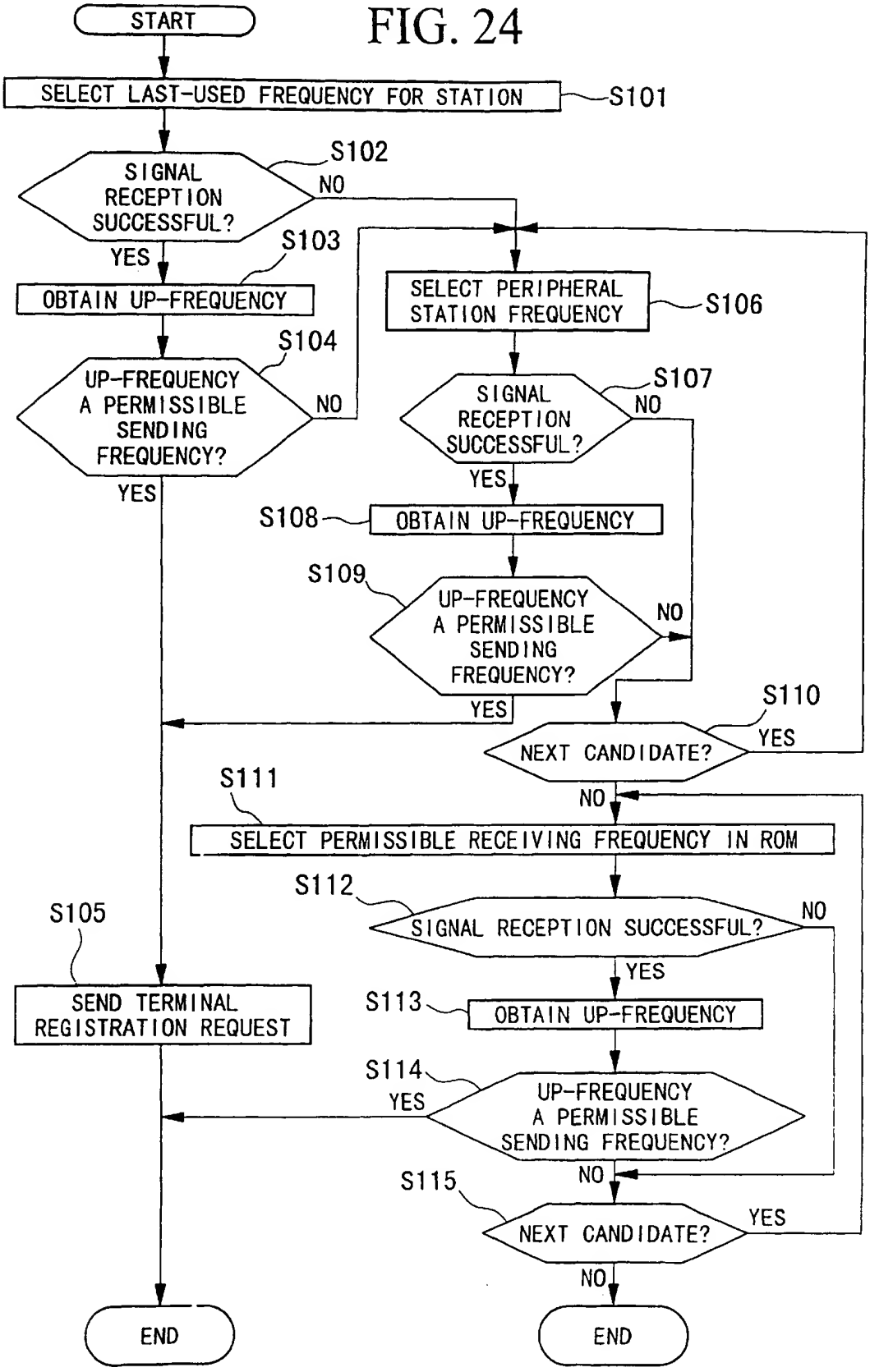

START
SELECT LAST-USED FREQUENCY FOR STATION
S101
S102
SIGNAL RECEPTION SUCCESSFUL?
NO
YES
S103
OBTAIN UP-FREQUENCY
S104
UP-FREQUENCY A PERMISSIBLE SENDING FREQUENCY?
NO
YES
SELECT PERIPHERAL STATION FREQUENCY
S106
S107
SIGNAL RECEPTION SUCCESSFUL?
NO
YES
S108
OBTAIN UP-FREQUENCY
S109
UP-FREQUENCY A PERMISSIBLE SENDING FREQUENCY?
NO
YES
S110
NEXT CANDIDATE?
YES
NO
S111
SELECT PERMISSIBLE RECEIVING FREQUENCY IN ROM
S112
SIGNAL RECEPTION SUCCESSFUL?
NO
YES
S105
SEND TERMINAL REGISTRATION REQUEST
S113
OBTAIN UP-FREQUENCY
S114
YES
UP-FREQUENCY A PERMISSIBLE SENDING FREQUENCY?
NO
S115
NEXT CANDIDATE?
YES
NO
END
END

FIG. 25

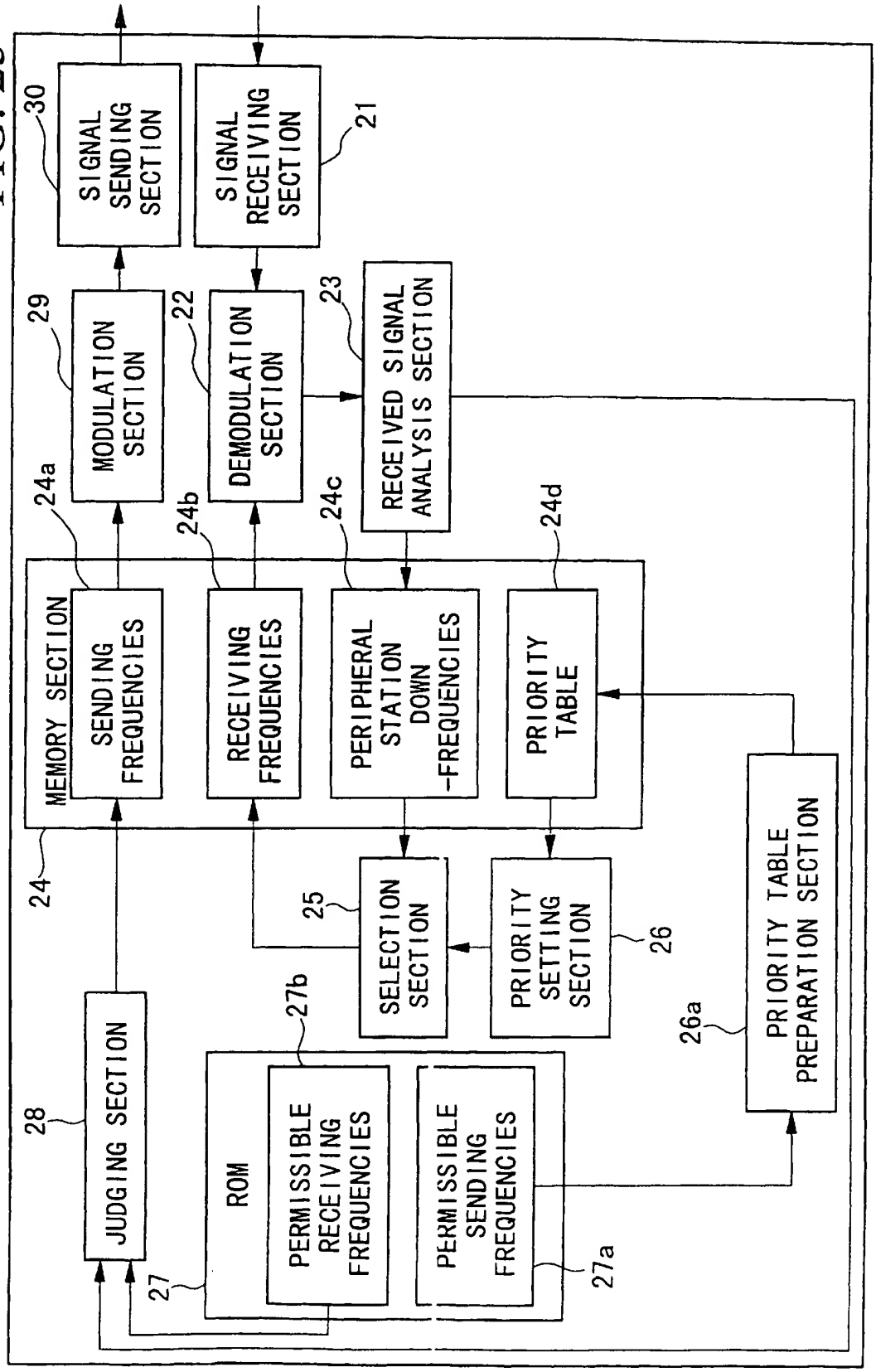

SIGNAL SENDING SECTION
30
SIGNAL RECEIVING SECTION
21
MODULATION SECTION
29
DEMODULATION SECTION
22
RECEIVED SIGNAL ANALYSIS SECTION
23
24a
24b
24c
24d
MEMORY SECTION
SENDING FREQUENCIES
RECEIVING FREQUENCIES
PERIPHERAL STATION DOWN -FREQUENCIES
PRIORITY TABLE
24
SELECTION SECTION
25
PRIORITY SETTING SECTION
26
PRIORITY TABLE PREPARATION SECTION
26a
JUDGING SECTION
28
ROM
27
27b
PERMISSIBLE RECEIVING FREQUENCIES
PERMISSIBLE SENDING FREQUENCIES
27a

FIG. 26A

DISTRICT NAME	USEABLE CHANNEL NUMBER
a	1, 2, 3, 4, 5, 6
b	1, 5, 6, 7, 9
c	1, 2, 6, 7, 8
d	9, 10, 11, 12

FIG. 26B

CHANNEL NUMBER	PERMISSIBLE FREQUENCY
1	f1
2	f2
3	f3
4	f4
5	f5
6	f6
7	f7
8	f8
9	f9
10	f10
11	f11
12	f12

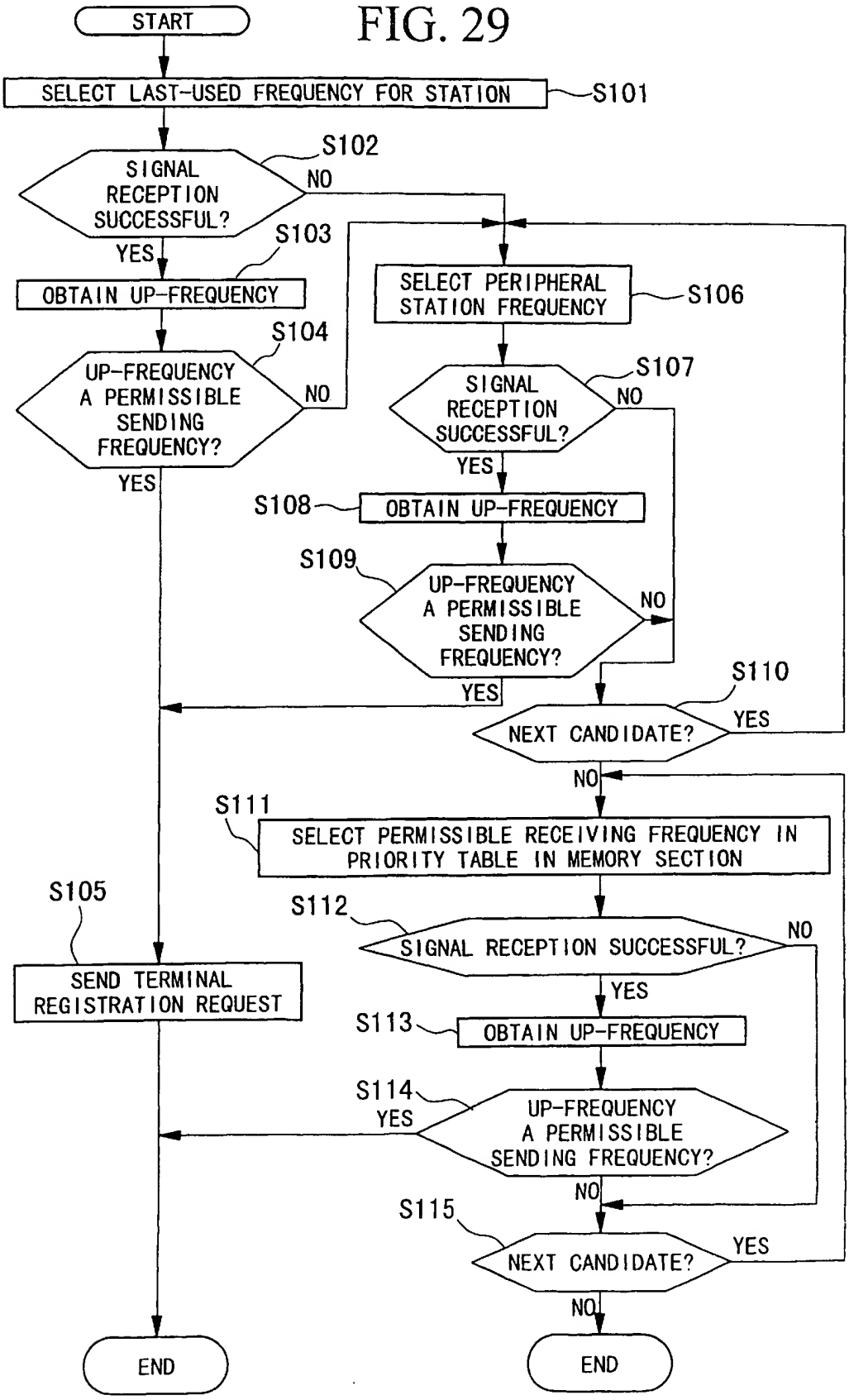
FIG. 27

CHANNEL NUMBER	OPERATING DISTRICT NAMES	NUMBER OF DISTRICTS	PERMISSIBLE RECEIVING FREQUENCY
1	a, b, c	3	f1
2	a, c	2	f2
5	a, b	2	f5
6	a, b	2	f6
7	b, c	2	f7
9	b, d	2	f9
3	a	1	f3
4	a	1	f4
8	c	1	f8
10	d	1	f10
11	d	1	f11
12	d	1	f12

FIG. 28

CHANNEL NUMBER	OPERATING DISTRICT NAMES	NUMBER OF DISTRICTS	PERMISSIBLE RECEIVING FREQUENCY
1			f1
2			f2
5			f3
6			f4
7			f5
9			f6
3			f7
4			f8
8			f9
10			f10
11			f11
12			f12

FIG. 29


START
SELECT LAST-USED FREQUENCY FOR STATION
S101
S102
SIGNAL RECEPTION SUCCESSFUL?
NO
YES
S103
OBTAIN UP-FREQUENCY
S104
UP-FREQUENCY A PERMISSIBLE SENDING FREQUENCY?
NO
YES
SELECT PERIPHERAL STATION FREQUENCY
S106
S107
SIGNAL RECEPTION SUCCESSFUL?
NO
YES
S108
OBTAIN UP-FREQUENCY
S109
UP-FREQUENCY A PERMISSIBLE SENDING FREQUENCY?
NO
YES
S110
NEXT CANDIDATE?
YES
NO
S111
SELECT PERMISSIBLE RECEIVING FREQUENCY IN PRIORITY TABLE IN MEMORY SECTION
S105
S112
SIGNAL RECEPTION SUCCESSFUL?
NO
SEND TERMINAL REGISTRATION REQUEST
YES
S113
OBTAIN UP-FREQUENCY
S114
YES
UP-FREQUENCY A PERMISSIBLE SENDING FREQUENCY?
NO
S115
NEXT CANDIDATE?
YES
NO
END
END

WIRELESS SERVER, SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates in general to wireless servers for communicating user terminal devices wirelessly to Internet, and relates in particular to a wireless server system that can provide a seamless service to a terminal unit when the terminal unit moves from one managing district to another managing district.

2. Description of the Related Art

There has been an increasing need for mobile computing in recent years. Mobile computing performs information processing by connecting to an existing Internet service network through a mobile-phone circuit, for example. A feature of the circuit used for mobile computing is that it enables communications from mobile sites by utilizing mobile phone circuits.

However, communication devices dependent on the conventional wired communication network operate on communication protocols that are designed for fixed communication services, and present a problem that communication is terminated when a terminal unit moves to a location beyond the capability of sub-net services. Further, there are problems of excessive time of waiting to be connected to the telephone network, and if the line is congested, it may be impossible to secure a line.

SUMMARY OF THE INVENTION

It is an object of the present invention to address the above-identified and other short-comings of conventional systems and methods. A consistent object is to provide a communication system and method that can continue to communicate without using telephone circuits, even when a terminal unit moves out of a sub-net district.

The objects are achieved in a wireless server system and method, for wirelessly connecting a terminal unit having a terminal device and wireless mobile device to the Internet, including not less than one wireless server for communicating with Internet; and a plurality of wireless station devices connected to the wireless server for wireless communication with the terminal unit by way of the wireless mobile device; wherein one wireless server within a district of communication range of the wireless station devices is designated as a home server for the wireless mobile device, and the terminal device communicates with Internet by way of the wireless mobile device.

An advantage of the present server system and method is that, because one wireless server is designated as the home server for the wireless mobile device, within a managing district of the home server that can communicate with the wireless mobile devices and the home server performs the tasks of approving a terminal connection and issuing an Internet Protocol, IP, address, the mobile device is able to carry on communicating in managing districts other than the managing districts of the home server.

The objects have also been achieved in a wireless mobile device that includes a memory section for storing a last operational frequency used by the wireless mobile device and down-frequencies of a peripheral wireless station device; a read-only-memory section for storing permissible operational frequencies for sending and receiving data through the wireless mobile device; and a judging section for comparing frequencies stored in the memory section and permissible operational frequencies stored in the read-only-memory section, and judging whether or not an operational frequency to be used by the wireless mobile device is useable; wherein up-frequencies transmitted from the wireless station device are tested by using successively the last receiving frequency, the down-frequencies of the peripheral wireless station device and the permissible receiving frequencies so that a terminal registration request is transmitted only when a received up-frequency matches a receiving frequency permitted for the wireless mobile device.

An advantage of the present wireless mobile device is that it is only necessary to search among the down-frequencies of the peripheral station devices to find a useable frequency, because a down-frequency can be selected by the wireless terminal unit for sending a terminal registration request to a wireless server.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

FIG. **1** is a block diagram of a structure of a wireless network according to Embodiment 1 of the present invention;

FIG. **2** is a schematic illustration of a process of packet transmission in Embodiment 1;

FIG. **3** is a flowchart for a registration portion of a process of packet transmission in Embodiment 1;

FIG. **4** is a flowchart for a host server packet transmit portion of the process of packet transmission in Embodiment 1;

FIG. **5** is a flowchart for a terminal transmit portion of the process of packet transmission in Embodiment 1;

FIG. **6** is a flowchart for another portion of the process of packet transmission in Embodiment 1;

FIG. **7** is an illustration of steps for issuing addresses in Embodiment 1;

FIG. **8** is an illustration of an exemplary system component layout for terminal identification in Embodiment 1;

FIG. **9** is an illustration of the steps for terminal identification in Embodiment 1;

FIG. **10** is a block diagram of a structure of a wireless server B according to Embodiment 2 of the present invention;

FIG. **11** is a flowchart for steps taken by a wireless server B in Embodiment 2;

FIG. **12** is an illustration of an address system used in Embodiment 3 of the present invention;

FIG. **13** is a block diagram of a structure of a network in Embodiment 4 of the present invention;

FIG. **14** is a block diagram of a structure of a wireless server B for performing simultaneous reporting in Embodiment 4;

FIG. **15** is a block diagram of a structure of a terminal unit **5-1** for receiving broadcast information in Embodiment 4;

FIG. **16** is a flowchart for an operation of a wireless server B**3-2** shown in FIG. **14**;

FIG. **17** is a flowchart for an operation of the terminal unit **5-1** shown in FIG. **15**;

FIG. **18** is an illustration of a format of broadcast information;

FIG. **19** is a block diagram of a structure of a wireless server B3-2 for performing multi-casting in Embodiment 5 of the present invention;

FIG. **20** is a flowchart for an operation of the wireless server B3-2 shown in FIG. **19**;

FIG. **21** is a block diagram of a structure of the wireless network in Embodiment 6 of the present invention;

FIG. **22** is a block diagram of the structure of the wireless station devices **4-2–4-4**;

FIG. **23** is a block diagram of the structure of the terminal unit **5-1**;

FIG. **24** is a flowchart for the operation of the terminal unit **5-1** shown in FIG. **21**;

FIG. **25** is a block diagram of the structure of a terminal unit **5-1** in Embodiment 7 of the present invention;

FIG. **26** is a diagram of the table containing permissible receiving frequencies **27***a* shown in FIG. **25**;

FIG. **27** is an illustration of the priority table **24***d* shown in FIG. **25**;

FIG. **28** is an illustration of the priority table **24***d* shown in FIG. **25**; and

FIG. **29** is a flowchart for the operation of the terminal unit **5-1** shown in FIG. **25**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following embodiments are presented for illustrative purposes only and are not meant to limit the invention defined by the appended claims. Also, to achieve the above-described and other objectives, not all combinations of features presented in the embodiments are required at all times.

Embodiment 1

In the following, the wireless server system will be presented with reference to the drawings. FIG. **1** shows a block diagram of the structure of the system in Embodiment 1. The system includes: a host server **1**; a network **2** connected to the first server **1**; wireless servers **3-1~-3** connected to the network **2**; sub-networks **2***a*, **2***e*, **2***f*, which are managed by the wireless servers **3-1~3**; and wireless station devices **4-1**, **4-5**, **4-6** connected to respective wireless servers **3-1~3**. Normally, a plurality of immobile wireless station devices **4-n** are connected to one wireless server **3-n**, but in this illustration, only one station device **4-n** is shown for one wireless server **3-n**. The system serves terminal units, represented in this case by one terminal unit **5-1**, connected to the wireless server **3-2** for wireless communication with the wireless station devices **4-5**. The terminal unit **5-1** includes a wireless mobile device **5***a* and a computer terminal (referred to hereinbelow as the terminal device) **5***b* connected to the wireless mobile device **5***a*.

The host server **1** may be a wireless server to communicate with the terminal, but it does not necessarily have a wireless communication function.

Any one of the wireless servers **3-n** connected to the network **2** can serve as the home server for the terminal unit **5-1**. In the diagram shown in FIG. **1**, the wireless server **3-3** is designated as the home server for the terminal unit **5-1**.

Next, the operation of the wireless server system of Embodiment 1 will be explained with reference to FIGS. **1**, **2**, **3**, **4**, **5** and **6**.

FIG. **2** illustrates the operation of the wireless server system to manage the movement of a terminal unit. Mailing destination is indicated by "dst" and mailing source is indicated by "src". FIGS. **3**, **4**, **5** and **6** are flowcharts for the operational steps of the wireless server system.

In this case, It is assumed that the home server for the terminal unit **5-1** is the wireless server C3-3, and that the terminal unit **5-1** is presently operating under the direction of the wireless server A3-1.

First, the following explanation pertains to the operation of the system when the terminal unit **5-1** moves from sub-network **2***a* managed by the wireless server A3-1 to sub-network **2***e* managed by the wireless server B3-2. The terminal unit **5-1** requests from wireless server B3-2 a terminal registration approval and an IP address (refer to (a) in FIG. **2**, step S1 in FIG. **3**). In response, wireless server B3-2 issues registration approval and an IP address (refer to (a), and step S2 in FIG. **3**), thus enabling the terminal unit **5-1** to operate under the wireless server B3-2.

Processes for approving the terminal registration request and issuing an IP address will be explained later.

Next, wireless server B3-2 notifies the wireless server C3-3, which is the home server for the terminal unit **5-1**, that the terminal unit **5-1** has moved from the managing district of wireless server A3-1 to the managing district of wireless server B3-2, and that the terminal registration has been effected (refer to (b) in FIG. **2**, and step S3 in FIG. **3**).

Next, in response to the registration completion report from wireless server B3-2, the wireless server C3-3, as the home server, notifies wireless server A3-1 that the terminal unit **5-1** has moved into the managing district of wireless server B3-2 (step S5 in FIG. **3**). Accordingly, upon receiving the registration completion report from the wireless server C3-3 (step S4 in FIG. **3**), wireless server A3-1 stops managing the terminal unit **5-1** (step S6 in FIG. **3**). In the meantime, wireless server C3-3 (home server) records that the terminal unit **5-1** is now in the managing district of B3-2, thereby updating the managing information (step S7 in FIG. **3**).

The reason for using the home server C3-3 to notify wireless server A3-1 that the terminal unit **5-1** has moved is that, by so doing, the home server will be able to recognize the managing district in which the terminal unit **5-1** is now operating.

By following the above steps, the terminal unit **5-1** can move about to other managing districts.

Next, the steps for the host server **1** to transmit a packet to the terminal unit **5-1** will be explained with reference to FIGS. **2** and **4**.

First, the host server **1** transmits an IP packet through the network **2** (step S11 in FIG. **4**). At this time, because the host server **1** has not been notified of the movement of the terminal unit **5-1** to managing district B3-2, the packet is sent to wireless server A3-1 to which the terminal unit **5-1** had been connected previously (refer to (c) in FIG. **2**).

Upon receiving the packet in wireless server A3-1 (step S12 in FIG. **4**), the packet is routed to wireless server B3-2 (step S13 in FIG. **4**, and (d) in FIG. **2**), and is received by wireless server B3-2 (step S14 in FIG. **4**). Further, wireless server B3-2 routes the packet to the wireless mobile device **5***a* of the terminal unit **5-1** which is operating within its managing district (step S15 in FIG. **4**), and the packet is delivered to the wireless mobile device **5***a* (refer to (e) in FIG. **2**), and from there to the terminal device **5***b* (refer to (f) in FIG. **2**).

The packet forwarded from the host server **1** is thus received by the terminal unit **5-1**.

Next, the steps for sending a packet from the terminal unit **5-1** to the host server **1** will be explained with reference to FIGS. **2**, **5** and **6**.

First, the terminal device **5***b* transmits a packet to the wireless mobile device **5***a* ((g) in FIG. **2**). Next, the wireless

mobile device **5***a* transmits the packet to the host server **1** by way of the wireless server **B3-2** ((h) in FIG. **2**).

Next, wireless server **B3-2** receives the packet (step **S21** in FIG. **5**) and routes the packet to the host server **1** and sends the packet received from the terminal unit **5-1** to the host server **1** ((i) in FIG. **2**, step **S22** in FIG. **5**).

Next, the host server **1** receives the packet (step **S23** in FIG. **5**). Upon receiving the packet, the host server **1** now knows that the terminal unit **5-1** is in the managing district of wireless server **B3-2** because of the source address of the packet (step) **S24** in FIG. **5**). Therefore, all subsequent packet transmission to the terminal unit **5-1** will be made directly to wireless server **B3-2**.

Next, the process of sending the packet from the host server **1** to the wireless server **B3-2** is carried out by first sending the packet to wireless server **B3-2** ((j) in FIG. **2**, step **S31** in FIG. **6**).

Next, the wireless server **B3-2** receives the packet (step **S32** in FIG. **6**), and routes it to the terminal unit **5-1** (step **S33** in FIG. **6**) and delivers the packet to the wireless mobile device **5***a* ((k) in FIG. **2**), from which the packet is sent to the terminal device **5***b* ((in) in FIG. **2**).

The above manner of only informing the host server when a packet is sent from the terminal unit **5-1** provides an advantage of avoiding congestion of data traffic because of the elimination of the necessity of informing all the host servers on each move of the terminal unit **5-1**.

Next, the operation of issuing an IP address will be explained with reference to FIG. **7**.

First, when the terminal unit **5-1** moves into the managing district of wireless server **B3-2**, the terminal unit **5-1** sends an IP address request to the wireless server **B3-2**.

Next, the wireless server **B3-2** deduces the home server for the terminal unit **5-1** (wireless server **C3-3** is the home server in this case), and sends an IP address request to the wireless server **C3-3**.

Next, an IP address allocation request is made to DHCP wireless server **6-3**, which is a wireless server for issuing IP addresses and is connected to the wireless server **C3-3** (home server). In response, DHCP wireless server **6-3** issues an IP address presently available for use, and the wireless server **C3-3** is informed of the IP address issued.

Next, the wireless server **C3-3** forwards the issued IP address to the terminal unit **5-1** by way of the wireless server **B3-2**.

In this process, if the wireless server **B3-2** is the home server for the terminal unit **5-1**, an IP address is obtained directly from a DHCP wireless server **6-2**.

The above process of issuing an IP address provides an advantage that even when the terminal unit **5-1** is operating under the managing district of wireless server **B3-2**, an IP address issued by the wireless server **C3-3** can be used as though the terminal unit **5-1** is operating in the managing district of wireless server **C3-3**, so that the packet transmission to the terminal unit **5-1** is allowed to be carried out by way of the wireless server **B3-2**.

Next, the process of approving a terminal registration request will be explained with reference to FIGS. **8** and **9**.

First, the terminal unit **5-1** sends a terminal registration request and its identifier number to the wireless server **B3-2** ((a) in FIG. **9**).

Next, the wireless server **B3-2** searches in the database **7-2** connected to the wireless server **B3-2** to find out whether or not the identification data of the terminal unit **5-1** is included. If the identification data do not exit in the database **7-2**, the wireless server **B3-2** judges that it is not the home server for the terminal unit **5-1**, and deduces the home server for the terminal unit **5-1** according to the identifier number received, and transfers the approval request to the home server (in this case, wireless server **C3-3**) ((b) in FIG. **9**).

At this time, if the home server cannot be deduced from the identifier number of the terminal unit **5-1** received, the terminal registration request is sent to a pre-determined wireless server (wireless server **A3-1**, in this case). If the identifier number is not included in the database **7-1** of wireless server **A3-1**, the terminal registration request is sent to a predetermined wireless server (wireless server **C3-3**, in this case). These actions are repeated until the home server of the terminal unit **5-1** is notified of the terminal registration.

In the above process, the registration request is accompanied by the identifier number of the terminal unit **5-1** and a random number generated by the wireless server **B3-2**. This random number is sent to the terminal unit **5-1** also ((c) in FIG. **9**).

Next, the wireless server **C3-3** which is the home server for the terminal unit **5-1** receives the approval request, and performs an approval computation using the random number and the identifier number received from the wireless server **B3-2**.

Next, the wireless server **C3-3** returns the result of approval computation to the wireless server **B3-2** ((d) in FIG. **9**).

In the meantime, the terminal unit **5-1** performs an approval computation using the random number received from the wireless server **B3-2**, and returns the result to the wireless server **B3-2** ((e) in FIG. **9**).

Next, the wireless server **B3-2** compares the results of approval computation received from the wireless server **C3-3** and the terminal unit **5-1** ((f) in FIG. **9**). Then, when the check process shows that the two are identical, the registration request is approved ((g) in FIG. **9**). If the check reveals that the two are not identical, it regards that the registration request is improper, and denies the approval request.

On the other hand, if the identification data exist in the database **7-2**, the wireless server receiving the approval request is the home server for that wireless mobile device, therefore, approval operation consists only of: "registration request" ((a) in FIG. **9**), "approval request" ((c) in FIG. **9**), "approval response" ((e) in FIG. **9**), "registration acceptance" ((g) in FIG. **9**).

Accordingly, approval for a terminal registration for the terminal unit **5-1** can be carried out even when the terminal unit **5-1** is not under the managing district of a wireless server which is its home server.

Embodiment 2

Next, the operation of the wireless server **B3-2** in issuing an IP address will be explained in more detail.

FIG. **10** shows a block diagram of the structure of the wireless server **B3-2** including a network connection section **3***a* for connecting to the network **2**; a relay agent section **3***b* for sending an address request to DHCP wireless server **6-3**, in response to an IP address request sent from the terminal unit **5-1**, and receiving the IP address issued by DHCP wireless server **6-3**; a terminal connection section **3***c* for establishing communication with the terminal unit **5-1** by way of the wireless station device **4-5**; and a home server defining section **3***d* for defining the home servers for individual wireless mobile devices.

Next, the process of issuing an IP address from the wireless server **B3-2** will be explained with reference to FIGS. **10**, **11**. FIG. **11** shows a flowchart showing the steps taken by the wireless server **B3-2**.

First, the terminal connection section 3*c* in the wireless server B3-2 receives an IP address request sent from the terminal unit 5-1 by way of the wireless station device 4-5 (step S41). At this time, the terminal unit 5-1 broadcasts (meaning sending the same packet simultaneously to all the devices connected within the network) the IP address request. In response, the wireless server B3-2 judges whether the IP address request is from the terminal unit 5-1 and if it is, the IP address request is accepted.

The IP address request packet includes the identifier ID for the terminal unit 5-1 that is sending the request. The identifier ID is a media access control (MAC) address belonging to the terminal unit 5-1. A MAC address is an identifier number allocated to the hardware of the terminal unit 5-1.

Next, when the received packet is an IP address request from the terminal unit 5-1, the terminal connection section 3*c* forwards the received packet to the relay agent section 3*b*.

Then, the relay agent section 3*b* extracts from its content the identifier ID of the terminal unit 5-1, and by consulting the contents of the home server defining section 3*d*, deduces an identifier ID to correspond to the wireless mobile device making the request (step S42).

The home server defining section 3*d* is provided with a table relating identifiers IDs of individual terminal unit 5-1 and the IP addresses of home servers of terminal unit 5-1 corresponding to the identifier IDs. By consulting the table, the relay agent section 3*b* deduces the IP address of the home server for the terminal unit 5-1 having the identifier ID received therein.

Next, the relay agent section 3*b* sends an IP address request packet on behalf of the terminal unit 5-1 to the home server (wireless server C3-3 in this case) through the network connection section 3*a* (step S43). At this time, the source address of the sent packet is the IP address of the wireless server B3-2, and the destination address is the IP address of the deduced home server.

Here, if the data of the terminal unit 5-1 do not exist the home server defining section 3*d* of the wireless server B3-2, i.e., when the home server cannot be deduced from the received identifier ID, the IP address request is sent to a pre-determined wireless server (A-3, in this case). If the data do not exist in the home server defining section 3*d* of the second wireless server, the IP address request is sent to another pre-determined wireless server (C3-3, in this case). By repeating the steps until the home server of the terminal unit 5-1 is found, the IP address request is delivered to the home server of the terminal unit 5-1. Accordingly, a home server for a terminal unit can be deduced under any circumstance.

Next, the wireless server C3-3 receiving the IP address request packet sends an IP address request to the DHCP wireless server 6-3. In response to the request, the DHCP wireless server 6-3 issues an IP address presently available for use, and sends it to the wireless server C3-3. In response, the wireless server C3-3 sends the packet containing the IP address issued by the DHCP wireless server 6-3 to the wireless server B3-2 that sent the IP address request packet.

Next, the network connection section 3*a* receives the packet sent by the wireless server C3-3 (step S44). The network connection section 3*a* judges whether the received packet is a response packet replying to the IP address request, and when it is the response packet, the packet is forwarded to the relay agent section 3*b*.

Next, the relay agent section 3*b* receiving the response packet from the network connection section 3*a* attaches the identifier ID of the terminal unit 5-1, and forwards the packet to the terminal connection section 3*c*.

Next, the terminal connection section 3*c* distributes the response packet to the terminal unit 5-1 by broadcasting (step S45). Then, the terminal unit 5-1 checks whether the identifier ID is included in the broadcast packet for the terminal unit 5-1, and if it is contained, the terminal unit 5-1 extracts the IP address from the packet.

The process of issuing an IP address to a terminal unit 5-1 presently requesting an IP address, from a wireless server that is not the home server provides an advantage that any terminal unit is able to access any other wireless servers without changing the settings of the IP address of the terminal unit 5-1.

Also, normal broadcasting systems do not allow a terminal unit to broadcast beyond own network (with which it is presently communicating) to other terminal units connected to other networks. However, the present broadcast system allows an IP address request to be made to a DHCP wireless server connected to any network, because of the provision of a relay agent section for sending/receiving an IP address request packet on behalf of the terminal unit.

Embodiment 3

Next, an address address band system for the wireless server B3-2, wireless station devices 4-2-5 and the wireless mobile device 5*a* will be explained with reference to FIG. 12. In FIG. 12, an IP address for the wireless server B3-2 is assumed to be, for example, [172.31. 0.254], and the IP addresses for the wireless station devices 4-2-5 to be [172. 31. 31. 254], [172. 31. 47. 254], [172. 31. 63. 254][172. 31. 79. 254], respectively.

Also, an IP address of one wireless mobile device 5*a* among the many wireless mobile devices communicating with the wireless station devices 4-2-5 is assumed to be [172. 31. 0. 1].

An IP address is usually expressed in 32-bits and decimal notation, and each group of 8-bits is separated by a period [.]

In the following explanation, the numerals separated by [.] are referred to, from the left, as first numeral, second numeral, third numeral and fourth numeral.

The third numerals [31], [47], [63], and [79], in the wireless station devices 4-2-5, are expressed so that the higher 4-bits are [0001], [0010], [0011], [0.100] and all the lower bits are [1111]. Also, the third and fourth numeral for all the wireless station devices are pre-selected for each device by the respective wireless server. As an example, all the wireless station devices can be expressed as [1111110] (representing 254 in decimal notation). The lower 4-bits in the third numeral and the numeral [1111 1111 110] represented by the fourth numeral indicate that this device is a wireless station device, and the upper 4-bits in the third numeral distinguish individual wireless station devices.

Also, the first numeral and the second numeral represent the wireless server B3-2 to which the wireless station devices 4-2-5 are connected.

Such designations by IP addresses allow to identify a wireless server connected to each of the wireless station devices 4-2-5 as well as to identify the numerical order of the devices within the station.

With respect to identifying the wireless mobile device 5*a*, the lower 12-bits of the 32-bit IP address are assigned by the wireless server B3-2. Therefore, it is possible to know to which wireless station device the wireless mobile device 5*a* is connected, by selecting an IP address for the wireless mobile device 5*a* according to the IP addresses assigned to the wireless server B3-2 and the wireless station devices 4-2~5.

Accordingly, by providing IP addresses to the wireless station devices, and using integrated services digital network

(ISDN) routers A, B for the communication between the wireless server B3-2 and the wireless station device 4-3, communications can be carried out regardless of how far apart the wireless server B3-2 is from the wireless station device 4-3, without changing the configuration shown in FIG. 12.

As explained above, by proving a wireless server as a home server for terminal devices, and providing terminal identifying mechanisms and terminal managing mechanisms to the wireless server so that terminal connection approval and IP address issuance can be performed by the home server, communications are possible even when the terminal device is located in managing districts other than the district managed by the home server.

Also, in the present system, an IP address request made from a terminal device to a wireless server, which is not the home server for the terminal device, is processed through its home server by way of the presently communicating wireless server, therefore, it is possible to contact other wireless servers without changing the settings of the IP address of the terminal device.

Also, the above manner of informing the host server only when packet transfer occurs from the wireless terminal unit provides an advantage of avoiding congestion of data traffic, because of the elimination of the necessity of informing all the host servers for each move of the terminal unit 5-1.

Also, IP addresses are allocated also to the wireless station devices so that the Internet protocol and ISDN routers can be used for communicating between the terminal devices and the wireless server, thereby enabling the communications to be maintained regardless of the separation distance between the wireless server and the wireless station devices, without having to alter the configuration of the system.

Embodiment 4

Next, the operating of broadcasting information to individual wireless terminal unit 5-1 will be explained in the following.

FIG. 13 shows a block diagram of the overall structure of the system including: a broadcasting terminal 1*a* for preparing and broadcasting information; a wireless server B3-2 connected to the terminal 1*a* by a network 2; four wireless station devices 4-2-5 connected to the wireless server B3-2; and individual terminal units 5-1-4 communicate with the respective wireless station devices 4-2-5.

It should be noted that although four wireless station devices 4-2-5 for the wireless server B3-2 are shown in the drawing, any number of devices may be connected as needed.

Also, while one terminal unit 5-1 is shown for each wireless station device 4-2, for example, each station device may communicate with more than two terminal unit 5-1.

Also, one the terminal unit 5-1 is shown for each wireless station device 4-2, for example, each station device may communicate with more than two terminal unit 501.

Next, a broadcasting operation from the broadcasting terminal 1*a* will be explained with reference to FIG. 13. The term "broadcasting" means distributing the same information to a plurality of terminal devices simultaneously.

First, the operator prepares information for broadcasting using the terminal 1*a*.

An example of the broadcasting format is shown in FIG. 18. As shown in this illustration, broadcasting information includes a header section and a plurality of information sections. In this case, it is assumed that the information is divided into four sections.

In the header section are included, an identifier to indicate that the information i to be broadcast, network addresses for delivery of information, and sizes of the information files 1~4 that follow the header section.

It is rarely necessary that the same information is to all be broadcast to the terminal unit 5-1, so that the broadcast information is divided into a plurality of reception levels according to the subject matter. In the example shown in FIG. 18, the information is divided into four groups.

Dividing according to the reception levels can be explained using an example of broadcasting an emergency message according to the type of terminal devices as follows those belonging to individual persons (level 1), those belonging to self-governing bodies (level 3), those belonging to fire departments (level 7), and those belonging to police (level 15).

Accordingly, the terminals receiving broadcasting information is divided into prearranged reception levels, and are identified by the level numbers (referred to as broadcast levels).

In the example shown in FIG. 18, bits are assigned to information 1–4 to indicate the broadcast levels, so that when the bit is [1], the information is needed by the terminal having this level number. Information I is allocated to the lowest bit and information 4 is allocated to the highest bit.

For example, for those terminals requiring only information 1, only the lowest bit is [1] so that the level number is [1]. For those terminals requiring all the information 1–4, all four bits are [1] so that the level number is [15]. For those terminal requiring no information, level number is [0].

Accordingly, if there are four groups of information, there will be sixteen types of broadcast levels with level number ranging from [0] to [15].

Also, even when there is a large quantity of information to be broadcast, bit number can be increased to increase the number of levels.

Broadcast information is prepared by separating the information into a plurality of levels according to the broadcast levels.

Next, broadcasting terminal 1*a* broadcasts the prepared information to a specified network 2. The network to be broadcast is not limited to the network connected to the broadcasting terminal 1*a*, but can be selected by specifying other network addresses.

The broadcasting terminal may be constructed using a computer device having an input/output mechanism.

Next, the operation of the wireless server B3-2 for distributing the broadcast information to the terminal units 5-1-4 will be explained with reference to FIGS. 14, 16.

FIG. 14 shows a block diagram of the structure of the wireless server B3-2, and FIG. 16 shows a flowchart of the steps taken by the wireless server B3-2.

First, a broadcast information receiving section 3*e* provided in the wireless server B3-2 receives broadcast information distributed by the broadcasting terminal 1*a* (step S46) and stores this information in a broadcast information receiving section 3*e*.

At this time, the broadcast information receiving section 3*e* judges whether or not this is broadcast information depending on whether or not the identifier is included in the header to indicate that it is broadcast information.

Then, the broadcast information reconstruction section 3*f* accesses the information stored in the broadcast information receiving section 3*e*, while consulting the broadcast level defining section 3*l*, and reconstructs broadcast information so as to match the broadcast levels of the connected the terminal units 5-1~4 (step S47).

Reconstruction of broadcast information means that the types of information not needed by the terminal unit 5-1 are

eliminated so that the terminal units **5-1-4** may receive only the necessary information.

Also, in the broadcast level defining section **3***i*, there are defined the level numbers of the broadcast levels and communication channels of the terminal units **5-1~4** presently communicating with the wireless server **B3-2**.

Next, the channel selection section **3***g* refers to the broadcast level defining section **3***i*, and selects channels to correspond to the individual terminal units **5-1~4** (step **S48**) and forwards the reconstructed broadcast information to a sending section **3***h*.

Next, the sending section **3***h* transmits the broadcast information through a channel selected by the channel section **3***g* to the individual terminal units **5-1~4** (step **S49**).

In this case, if packet communication channels are already established between the wireless server **B3-2** and the terminal units **5-1-4**, the channel selection section **3***g* may transmit the packets by changing the receiver addresses to the addresses of the terminal unit **5-1**.

Accordingly, because the wireless server **B3-2** receives the grouped broadcast information, the wireless server **B3-2** reconstructs broadcast information according to the broadcast levels of the terminal units **5-1~4**, and transmits only the relevant information to the terminal units **5-1~4**, so that the system can operate more efficiently.

Next, the process of selecting broadcast information by the terminal unit **5-1** will be explained with reference to FIGS. **13**, **15** and **17**.

FIG. **15** shows a block diagram of the structure of the terminal unit **5-1**, and FIG. **17** shows a flowchart of the steps taken by the terminal unit **5-1**.

The operation of the terminal unit **5-1** will be explained with reference to FIGS. **15** and **17**.

First, as described above, broadcast information is prepared by the broadcasting terminal **1***a*, and the information is broadcast within the network **2**. Then, the wireless server **B3-2** receiving the broadcast information distributes the information in the as received condition.

In the following explanation, because the operation is the same for all the terminal units **5-1~4**, terminal unit **5-1** is chosen as the representative terminal.

When broadcast information is delivered from the wireless server **B3-2**, the receiving section (mobile device) **5***a* provided in the terminal unit **5-1** receives this information (step **S51**), and holds it in the receiving section **5***a*.

At this time, the receiving section **5***a* recognizes whether or not the information is broadcast information according to whether or not the broadcast identifier is included in the header section.

Next, the information extraction section **5***b* accesses the broadcast information stored in the receiving section **5***a*, while consulting the broadcast level defining section **5***d*, and extracts only the necessary information for the terminal unit **5-1** (step **S52**).

At this time, because the broadcast level of the terminal unit **5-1** is defined in the broadcast level defining section **5***d* shown in FIG. **15**, only the necessary information is extracted from the broadcast information.

Next, the information extraction section **5***b* displays the extracted information on a display section **5***c* (step **S53**).

Accordingly, only the necessary information for the terminal unit **5-1** is displayed on the display section **5***c* provided on the terminal unit **5-1**.

As described above, only the information required by the terminal unit **5-1** is extracted from the broadcast information so that the information processing efficiency is improved.

Also, because the process of information classification is carried out according to the broadcast level provided in the terminal unit **5-1**, the broadcasting terminal can select what information to be delivered to a terminal unit **5-1**, thus improving the information delivery efficiency.

It should be noted that although the system operation is exemplified by the use of wireless communication, terminal devices communicating with the wireless server **B3-2** may include wired devices. Also, the terminal configuration shown in FIG. **15** can be applied to wired devices.

It should be noted also that the terminal unit **5-1** shown in FIG. **12** may communicate directly with a network **2**.

It should also be noted that broadcast information is not limited to text data, other types of data such as audio data and customized signals are also applicable. In such cases, the display section **5***c* shown in FIG. **15** may be replaced with a speaker device for generating sounds, or an alarm device for generating an alarm sound in response to customized signals.

Embodiment 5

Embodiment 5, relating to a multi-cast system in which same information is distributed to a plurality of terminal unit **5-1**, will be explained with reference to FIGS. **1**, **13**, **19** and **20**. In contrast to a broadcasting which transmits the same information simultaneously to all the terminal unit **5-1**, transmits the same information simultaneously to specific units.

FIG. **19** shows a block diagram of the structure of the wireless server **B3-2**, which includes: a multi-cast information receiving section **3***j* which received information through a network **2**; a destination deciding section **3***k* for determining the delivery destinations; a sending section **3***m* for sending received information to the terminal unit **5-1**; and a terminal information memory section **3***n* for storing information on home server of the terminal unit **5-1** and a wireless server presently being connected.

FIG. **20** shows a flowchart of the steps of distributing multi-cast information to the terminal unit **5-1**.

It is assumed that the terminal unit **5-1** to communicate with the wireless server **A3-1**, wireless server **B3-2**, the wireless server **C3-3** shown in FIG. **1** have been classified into groups for receiving multi-cast information, and are provided with group identifiers ID. The group IDs are managed by the home servers for each of the terminal units **5-n**, a client table containing terminal IDs and group IDs for the terminal unit **5-n** is included in the terminal information memory section **3***n* of each home server.

First, the terminal unit **5-1** transmits a terminal registration request to the wireless server **B3-2**. At this time, the terminal unit **5-1** transmits its terminal ID. In response, the wireless server **B3-2** carries out the terminal registration process as described earlier. Then, the wireless server **B3-2** reports particulars of the terminal unit **5-1** to the home server (in this case wireless server **C3-3**), which registers this information. By this process, the home server (wireless server **C3-3**) is able to obtain an identification of the wireless server presently communicating with the terminal unit **5-1** that is requesting a terminal registration, and the group ID of the terminal unit **5-1**.

Next, when the registration process is completed, the home server reports to the wireless server **B3-2** the group ID of the terminal unit **5-1** registered presently. Upon receiving the group ID, the wireless server **B3-2** registers the group ID in the terminal information memory section **3***n*.

Accordingly, this process results in the terminal information memory section **3***n* in the wireless server **B3-2** to store a plurality of group IDs for those terminal units **5-n** whose home server is the wireless server **B3-2** as well as those terminal unit **5-n** whose home servers are other wireless servers located in other terminal managing districts.

Next, the operation, of the wireless server B3-2 to receive a multi-cast packet from a terminal unit, 5-1 and multi-casts the packet to specified terminal unit 5-1, will be explained in the following.

First, a terminal unit 5-n prepares multi-cast packet. The packet contains an identifier to indicate that the information is to be multi-cast, and address of the destination network and group ID for information distribution. The packet is then transmitted to the destination network. It should be noted that the terminal unit 5-n preparing multi-cast information can be connected to any network and the information can be delivered to any destination network.

Next, the information receiving section *3j* provided in the wireless server B3-2 receives multi-cast information (step S61). At this time, the information receiving section *3j* judges whether or not the information is multi-cast information on the basis of whether or not the identifier ID indicating multi-casting is included in the header. The received multi-cast information is stored in the information receiving section *3j*.

Next, destination deciding section *3k* accesses the multi-cast information stored in the information receiving section *3j*, while consulting the contents of the memory of the terminal information memory section *3n*, to decide the delivery destination (step S62). At this time, the destination deciding section *3k* selects terminal units for packet delivery, by extracting the group ID contained in the multi-cast information, and extracting those terminal units having the same group ID by referring to the content of the terminal information memory section *3n*. Packet delivery is made to those terminals that are presently communicating with the wireless server B3-2 if they have the same group ID. If they are not presently communicating, delivery is made later, once they are communicating.

On the other hand, if a terminal unit 5-1 whose home server is the wireless server B3-2 is presently communicating with another wireless server and has the same group ID for multi-casting delivery, the destination deciding section *3k* deduces the wireless server which is presently communicating with the terminal unit 5-1, and designates this wireless server to be a packet delivery destination.

Next, when the delivery destination has been decided, the destination deciding section *3k* transmits multi-cast information received in the information receiving section *3j* to individual terminal units 5-n through the sending section *3m* (step S63).

Accordingly, the features of this system are that the reference is made to the terminal information memory section *3n* to decide the terminal units for receiving multi-cast information, and that the reliability of information delivery is assured because multi-cast information can be transferred to the correct destination, even when the terminal unit 5-1 is connected to another wireless server.

It should be noted that the processes described in flow-charts shown in FIGS. 3, 4, 5, 6, 11, 16, 19 and 20 can be carried out by application programs recorded on a computer readable memory medium, and executing the program by a computer system. Computer system, in this context, includes any operating systems and peripheral hardwares that are connected (remotely or directly) to networks. Computer-readable recording media include portable media such as floppy discs, opto-magnetic discs, ROM, CD-ROM, as well as fixed devices such as hard discs housed in computer systems.

Computer-readable recording media include short-term dynamic memories used in transmitting programs and data through communication circuits such as Internet or telephone circuits, as well as other short-term memories such as volatile memories used in servers and client computer systems. Application program may perform a part of the described functions, or may be operated in conjunction with pre-recorded programs stored in computer systems.

In other words, a computer-readable recording medium containing a relay agent program for processing an IP address request should include functions so that the computer can execute tasks such as: processing an IP address request from a wireless mobile device; deducing a home server of the requesting wireless mobile according to a request content; issuing an IP address request on behalf of the requesting wireless mobile device; receiving an IP address issued by the home server; and distributing the received IP address to the requesting wireless mobile device.

Also, a computer-readable recording medium containing a terminal connection program for processing a terminal connection request should include approval functions so that the computer can execute tasks such as: identifying a terminal in response to a terminal registration request; issuing an IP address that is presently available for use.

Also, the terminal connection program should further include packet transfer functions so that the computer can execute a task that, when a terminal device moves from a previously-connected wireless server to a presently communicating wireless server that is not its home server, and packet data addressed to the terminal device are delivered to the presently communicating wireless server that is not its home server, and the packet data are routed to the presently communicating wireless server according to the IP address obtained from the home server of the subject terminal device.

Also, the terminal connection program should further include routing functions so that the computer can execute a task that, when the subject terminal device is presently communicating with a wireless server that is not its home server and packet data are transferred to the wireless terminal, a host server on the Internet that routed the packet data is advised of the identity of the presently communicating wireless server so that subsequent packet data are routed to the presently communicating wireless server.

Also, a computer-readable recording medium containing a broadcasting program for distributing information should include broadcasting functions so that the computer can execute tasks such as: receiving distributed broadcast information; extracting from the received broadcast information only the necessary information for the subject terminal device, while consulting the contents of the broadcast level defining section; and displaying only the required information on a display section of the subject terminal device.

Also, a computer-readable recording medium containing a multi-cast program for distributing information should include multi-casting functions so that the computer can execute tasks such as: receiving multi-cast data; deciding distribution destinations for the multi-cast data by consulting terminal information; and distributing multi-cast data according to decided delivery destinations.

Furthermore, the present wireless server system enables a terminal unit to continue to communicate in different managing districts so that this technologies can be utilized in the field such as: messages (such as e-mail, netnews, file transfer protocol (FTP)), voice mail, web broadcasting, computer telephony integration (CTI), information broadcasting, telemetering, intelligent transport system (ITS). Also, the system is applicable to the push-technology when used in conjunction with routing functions.

Embodiment 6

The wireless station device **4**-n and the terminal unit **5-1** shown in FIG. 1 will be explained with reference to FIGS. **21**~**24**.

FIG. **21** shows a block diagram of the overall configuration of the wireless server system which includes: a wireless server B3-2 a plurality of wireless station devices **4-2-5** wire-connected to the wireless server B3-2 using sending frequencies f1–f3; a terminal unit **5-1** for wireless communication with the wireless station device **4-5** which uses a sending frequency f0. The terminal unit **5-1** includes by a wireless mobile device **5***a* and a terminal device **5***b* and uses a sending frequency F0.

In the following explanation, the sending frequencies f0–f3 of the wireless station devices **4-2-5** are termed the "down-frequencies" and the sending frequency F0 of the wireless mobile device is termed the up-frequency.

FIG. **22** show a block diagram of the configuration of the wireless station devices **4-2-5**, which includes by: a server data receiving section **11** for receiving data sent from the wireless server B; a memory section **12** for storing the data received in the server data receiving section **11**; a ROM **13** for storing operational frequencies containing a plurality of values of up-frequency **13***a* and down-frequency **13***b;* judging sections **14, 15** for comparing data sent from wireless server B with data stored in ROM of a wireless station device **4**-n, and output results of comparison; a sending data preparation section **17** for receiving results of the judging sections **14, 15** and preparing sending data to be sent from the station device **4**-n; a modulation section **17** for modulating the data; and a signal output section **18** for sending the modulated data produced by the modulation section **17**.

FIG. **23** shows a block diagram of the configuration of the terminal unit **5-1** shown in FIG. **21** which includes: a signal receiving section **21** for receiving signals sent from the wireless station device **4**-n; a demodulator **22** for demodulating the received data, a received signal analysis section **23**; a memory section **24** for storing the operational frequencies; a frequency selection section **25** for selecting receiving frequency; a priority setting section **26** for selecting the order of receiving frequencies by the frequency selection section; a ROM **27** for storing frequencies that can be received by the terminal unit **5-1**; and judging section **28** for judging the sending frequency that can be used by the terminal unit **5-1**.

The operation of the wireless server B3-2, wireless station devices **4-2-5**, and the terminal unit **5-1** will be explained with reference to the drawings. In this case, wireless station device **4-5** is used as an example.

First, the wireless server B3-2, managing the wireless station devices **4-2-5**, informs each of the wireless station devices **4-2-5** what operational frequency can be used. At this time, the wireless server B3-2 transmits the same information to all the wireless station devices **4-2-5**, thereby enabling the wireless station devices **4-2-5** to know the operational frequencies of the other wireless station devices.

Next, the operation of the wireless station devices **4-5** will be explained.

The server data receiving section **11** provided in the wireless station device **4-5** receives the down-frequency information sent by the wireless server B3-2. Then, the server data receiving section **11** stores the received information in the memory section **12**. Then, the server data receiving section **11** stores data received by the peripheral wireless station devices (in this case, wireless station devices **4-2-4**) separately as up-frequency **12***a* for peripheral wireless station devices, up-frequency **12***b* and down-frequency **12***c* for own device.

Next, the judging section **14** compares up-frequency **13** a stored in ROM **13** with own up-frequency **12***b* stored in the memory section **12**. If the result shows that the own up-frequency **12***b* sent from the wireless server B3-2 is a permissible frequency, this up-frequency **12***b* is forwarded to the sending data preparation section **16**.

In parallel with the above process, the judging section **15** compares down-frequency **13***b* stored in ROM **13** with the own down-frequency stored in the memory section **12**. If the result shows that the own down-frequency **12***c* sent from the wireless server B3-2 is a permissible frequency, the down-frequency **12***c* is forwarded to the sending data preparation section **16** and the modulation section **17**.

Next, the sending data preparation section **16** converts up- and down-frequency information received from the judging sections **14, 15** to sending data. Concurrently, the sending data preparation section **16** converts information regarding the down-frequencies **12***a* for the peripheral wireless station devices to sending data. Then, the sending data preparation section **16** forwards the converted sending data to the modulation section **17**.

Next, the modulation section **17** uses the down-frequency received from the judging section **15** to modulate the sending data prepared by the sending data preparation section **16**. The modulated sending data are sent from the signal sending section **18**.

Next, the operation of the terminal unit **5-1** will be explained. FIG. **24** shows a flowchart of the steps taken by the terminal unit **5-1**.

First, the demodulation section **22** uses a receiving frequency **24***b* stored in the memory section **24** to attempt to receive signals from the signal receiving section **21** (step **S101**). This receiving frequency **24***b* is the frequency which was last-used for communication.

Next, it is examined whether the signal reception by the demodulator **22** was successful (step **S102**), and if successful, the received signal is demodulated and is forwarded to the received signal analysis section **23**.

Next, the received signal analysis section **23** analyzes the received signal, and stores the down-frequency of the peripheral wireless station device in the memory section **24** and obtains up-frequency (step **S103**) which is forwarded to the judging section **28**.

Next, the judging section **28** accesses the permissible seeding frequencies **27***b* stored in ROM **27**, and compares with the up-frequency received from the received signal analysis section **13**, and checks whether the up-frequency received is permissible for signal transmission (step **S104**). This judgment is based on whether the received up-frequency matches the sending frequencies **27***b* stored in ROM **27**. If the result indicates that it can be sent, the judging section **28** stores the up-frequency in the memory section **24**. Then, the modulation section **29** uses the sending frequency **24***a* stored in the memory section **24** to send the registration request from the terminal unit **5-1** (step **S105**). Also, when there is no need for sending the terminal registration, it is possible to eliminate the step of sending the request.

The registration request is sent by having the modulation section **29** access the sending frequency stored in the memory section **24**, and sending the signal from the signal sending section **30** at this frequency.

Accordingly, when the mobile wireless terminal has not moved, the use of the last used frequency to obtain the up-frequency enables to commence communication without performing the frequency selection step.

On the other hand, if signal reception is not possible in step **S102** and if the up-frequency is not a permissible

frequency in step S104, the selection section 25 checks the down-frequencies 24c of the peripheral wireless station device stored in the memory 24, and selects a receiving frequency according to the priority order stored in the priority setting section 26 (step S106). At this time, the selection section 25 compares the selected receiving frequency with the permissible receiving frequencies stored in the memory 27, and if the selected receiving frequency is a permissible frequency, this frequency is stored in the memory section 24.

Next, the demodulation section 22 uses the receiving frequency 24b stored in the memory section 24 to check whether the signal reception was successful (step S107), and if it was successful, received signal is demodulated which is forwarded to the received signal analysis section 23.

Next, the received signal analysis section 23 analyzes the received signal, and stores peripheral down-frequency in the memory section 24, and concurrently, obtains the up-frequency (step S108) which is forwarded to the judging section 28.

Next, the judging section 28 accesses the permissible sending frequencies 27b stored in ROM 27, and compares them with the up-frequency received from the received signal analysis section 23, and checks whether the up-frequency received is permissible for signal sending (step S109). This judgment is based on whether the received up-frequency matches the sending frequencies 27b stored in ROM 27. If the result indicates that it can be sent, the judging section 28 stores the up-frequency in the memory section 24. Then, the modulation section 29 uses the sending frequency 24a stored in the memory section 24 to send the registration request from the terminal unit 5-1 (step S105). Also, when there is no need for sending the terminal registration, it is possible to eliminate the step of sending the request.

Next, if signal reception was not possible in step S107 and if the up-frequency is not the permissible frequency in step S109, steps S106–S109 are repeated (step S110).

Next, in step S110, if there are no other candidates for the permissible down frequencies, the selection section 25 checks the permissible receiving frequencies 27a stored in ROM 27, and selects a receiving frequency according to the priority order stored in the priority order setting section 26 (step S111), which is stored in the memory section 24.

Next, the demodulation section 22 uses the receiving frequency 24b stored in the memory section 24 to check whether the signal reception was successful (step S112), and if it was successful, received signal is demodulated which is forwarded to the received signal analysis section 23.

Next, the received signal analysis section 23 analyzes the received signal, and stores peripheral down-frequency in the memory section 24, and concurrently, obtains the up-frequency (step S113) which is forwarded to the judging section 28.

Next, the judging section 28 accesses the permissible sending frequencies 27b stored in ROM 27, and compares them with the up-frequency received from the received signal analysis section 23, and checks whether the up-frequency received is permissible for signal sending (step S114). This judgment is based on whether the received up-frequency matches the sending frequencies 27b stored in ROM 27. If the result indicates that it can be sent, the judging section 28 stores the up-frequency in the memory section 24. Then, the modulation section 29 uses the sending frequency 24a stored in the memory section 24 to send the registration request from the terminal unit 5-1 (step S105). Also, when there is no need for sending the terminal registration, it is possible to eliminate the step of sending the request.

Next, if signal reception was not possible in step S112 or if the up-frequency is not the permissible frequency in step S114, steps S114 are repeated (step S115). Next, in step S115, if there are no other permissible receiving frequencies, the terminal unit 5-1 is not able to use the present managing district so that it is necessary to move to another managing district, and attempt the steps shown in FIG. 24.

When the wireless station device 4-5 shown in FIG. 21 has commenced communicating other terminal unit, the terminal unit 5-1 is in a standby state. In this condition, if the terminal unit 5-1 tries to send a packet to the wireless server B3-2, the wireless station device 4-5 cannot be accessed. In such a case, the terminal unit 5-1, using a receiving frequency of a peripheral station device (wireless station device 4-2-4, in this case) obtained in step S101 (FIG. 24) and stored in the memory section 24, acquires a sending frequency of the wireless station device 4-4-2 by following the steps S106–S109. This approach permits the terminal unit 5-1 to communicate immediately with the wireless station device 4-4-2 without changing the wireless server B3-2, thus eliminating the necessity for the step of terminal registration (FIG. 24).

Further, if the step S106–S109 are carried out while the terminal unit 5-1 is in the standby state, a packet can be sent out immediately without having to receive a new sending frequency of the wireless station device 4-2.

It is assumed that the contents of the memory section 24 shown in FIG. 23 remains intact in the last-used condition prior to turning off the terminal unit 5-1.

Embodiment 7

The structure of the terminal unit 5-1 and its operation in Embodiment 7 will be explained in the following.

FIG. 25 shows a block diagram of the configuration of the terminal unit 5-1. The differences of the this configuration and that shown in FIG. 23 are that a priority table 24d is provided in the memory section 24 and that a priority table generation section 26a, for generating a priority table 24d, is provided on the basis of permissible receiving frequencies 27a residing in ROM 27.

FIG. 26 shows an example of the structure of the table containing the permissible receiving frequencies 27a stored in ROM 27 shown in FIG. 25. As shown in this table, permissible receiving frequencies 27a are arranged in two tables. Possible channel table shown in FIG. 26A includes a district name field and a channel number field. The district name is used to distinguish the districts in which the wireless server B3-2 and the wireless station devices 4-2-5 are operating, so that for one wireless server B3-2, there is a managing district name. In this example, it is assumed that there are four wireless station devices 4-2-5 and it is assumed that they are designated by respective district names [a], [b], [c], [d]. Channel numbers define channels that can be used in each district, and in the district [a] for example, channel numbers 1, 2, 3, 4, 5 and 6 are operable.

Also, the frequency table shown in FIG. 26B includes the channel number field and the permissible receiving frequency field. The channel numbers are logical numbers allocated to each permissible receiving frequencies, and it is assumed, in this case, that the terminal unit 5-1 are able to use permissible receiving frequencies f1~f12 corresponding to channel numbers 1~12.

FIG. 27 shows the structure of the priority table 24d stored in the memory section 24. As shown in this diagram, the priority table 24d includes a channel number field, a district name field, a number of districts field, a permissible receiving frequency field. The district names relate to those districts using the frequencies of the assigned channel num-

bers. The number of districts relates to the number of district using the frequencies of the assigned channel numbers. For example, in FIG. **27**, channel number 1 are used in districts a, b, c, so that the number of district is three.

Next, the operation of the terminal unit **5-1** will be explained with reference to the drawings.

First, when the power is turned on for the terminal unit **5-1**, the priority table generation section **26***a* generates a priority table **24***d* in the memory section **24** by consulting the permissible receiving frequencies **27***a* stored in ROM **27**. The process of generating the priority table **24***d* will be explained in the following.

First, the priority table generation section **26***a* accesses the permissible receiving frequency table (refer to FIG. **26**B) of the permissible receiving frequencies **27***a* stored in ROM **27**, and enters the values in the respective fields in the priority table **24***d*. At this point, the channels numbers and permissible receiving frequencies become listed in respective fields of the priority table **24***d*, as shown in FIG. **28**.

Next, the priority table generation section **26***a* accesses the permissible frequency table (FIG. **26**A) of the permissible receiving frequencies **27***a* stored in ROM **27**, and enters the values in the respective fields in the priority table **24***d*. At this time, the priority table generation section **26***a* extracts district names using the channel numbers and enters the values in the district name field. In the example shown in FIG. **26**, channel number [1] is operating in district names [a], [b] and [c], therefore, [a], [b], [c] are entered in the district name field corresponding to channel 1 in the priority table **24***d*.

By repeating this step, the district names using channel numbers [1]–[12] are entered in the district name field. When the data entry process is completed, the priority table generation section **26***a* counts the number of districts using each channel number and the results are entered in the number of district field. At this point, for each channel number, the district names using the channel number and the number of districts using each channel number become listed in the priority table **24***d*.

Next, the priority table generation section **26***a* rearranges the data using the number of districts as the sort key so that the table shows a descending order of channel usage, listing the most frequently used channels at the top, thereby preparing the priority order table **24***d* shown in FIG. **27**.

By following the steps described above, the priority table **24***d* shown in FIG. **27** is prepared from the data in the permissible receiving frequency table and the permissible channel table giving the permissible receiving frequencies **27***a* shown in FIG. **26**.

Next, the operation of the terminal unit **5-1** shown in FIG. **25** will be explained with reference to FIG. **29**. The difference between the flowcharts shown in FIGS. **29** and **24** is that the step of selecting a permissible receiving frequency stored in ROM (step **S111**) is replaced with the step of selecting a permissible receiving frequency in the priority table (step **S111***b*) stored in the memory section.

In the flowchart shown in FIG. **29**, steps **S101–S110** are the same as the steps S1–S10 in FIG. **24**, therefore, explanations are omitted.

In FIG. **29**, step **S101** is executed after the priority table **24***d* is generated.

In step **S110**, when there are no candidates for a down-frequency, the selection section **25** checks from the top data in the priority table **24***d* stored in memory section **24**, through the priority setting section **26**, and selects a frequency corresponding to a channel number and assigns this frequency as the receiving frequency (step **S111***b*) and stores the frequency in the memory section **24**.

Next, it is examined whether the signal reception by the demodulator **22** was successful (step **S112**), and if successful, the received signal is demodulated and is forwarded to the received signal analysis section **23**.

Next, the received signal analysis section **23** analyzes the received signal, and stores a down-frequency of the peripheral wireless station device in the memory section **24** and obtains up-frequency (step **S113**) which is forwarded to the judging section **28**.

Next, the judging section **28** reads the permissible sending frequencies **27***b* stored in ROM **27**, and compares it with the up-frequency received from the received signal analysis section **23**, and checks whether the up-frequency received is permissible for signal transmission (step **S114**). This judgment is based on whether the received up-frequency matches the sending frequencies **27***b* stored in ROM **27**. If the result indicates that it can be sent, the judging section **28** stores the up-frequency in the memory section **24**. Then, the modulation section **29** uses the sending frequency **24***a* stored in the memory section **24** to send the registration request from the terminal unit **5-1** (step **S105**). Also, when there is no need for sending the terminal registration, it is possible to eliminate the step of sending the request.

Next, if signal reception was not possible in step **S112** or if the up-frequency is not the permissible frequency in step **S114**, steps **S111–S114** are repeated (step **S115**). Next, in step **S115**, if there are no other permissible receiving frequencies, the terminal unit **5-1** is not able to use the present managing district so that it is necessary to move to another managing district, and attempt the steps shown in FIG. **24**.

In FIG. **29**, steps **S101–S104** and **S106–S111** may be skipped, and after preparing the priority table **24***d*, step **S111***b* may be executed immediately afterward.

As described above, because the wireless mobile device has information regarding the operational frequencies from the wireless station devices, if signal reception becomes difficult, information on the operational frequencies can be used to switch to another operational frequency. Switching the operational frequency provides an advantage that, because there is no change in the managing server for the mobile device, the connection can be maintained without having to go through the registration and approval processes even when communicating with other wireless station devices.

Also, use of the priority table indicating the most popular receiving frequencies provides an advantage that a selection of receiving frequency is facilitated and the system operates at an optimum efficiency.

Also, chronological switching of operational frequency provides an advantage that redundant terminal registration can be avoided and the use of unauthorized up-frequencies can be avoided because only the permissible up-frequencies are accepted. Because the permissible frequencies and the operational frequencies of the station devices are stored in the mobile device in the order of popularity, the probability of accessing an operational frequency and the process of selecting an operational frequency are improved significantly.

It is assumed that the operating channels had already been input in ROM when the terminal unit **5-1** is activated.

The program s shown in FIGS. **24, 29** may be recorded on a computer-readable recording media such as floppy discs, CD-ROM, opto-magnetic discs, IC cards, DVD-ROM, so that computer means can execute application programs to select an operational frequency.

The application programs are totally or partially recorded on portable memory media such as floppy discs and

CD-ROM, and fixed memory devices such as hard discs. Application program may perform a part of the described functions, or may be operated in conjunction with pre-recorded programs stored in computer systems.

Computer-readable recording media include not only static memories, such as optomagnetic discs, but short-term dynamic memories used in transmitting programs and data through communication circuits such as Internet or telephone circuits, as well as other short-term memories such as volatile memories used in servers and client computer systems.

In other words, a computer-readable recording medium containing a frequency selection program for a wireless terminal unit should include processing steps of receiving a first up-frequency given by the wireless station device using a last receiving frequency of the wireless mobile device; judging whether or not the first up-frequency is a permissible sending frequency for the wireless mobile device, so that, if the up-frequency is permissible; sending a terminal registration request to the wireless station device using the up-frequency; however, if the last frequency is not useable, receiving a second up-frequency from a peripheral wireless station device using a down-frequency allocated to the peripheral wireless station device, judging whether or not the second up-frequency is a permissible sending frequency; and if the second up-frequency is permissible, sending the terminal registration request to the peripheral wireless station device using the second up-frequency; however, if the last receiving frequency and the second down-frequency of the peripheral wireless station device cannot be used by the wireless mobile device, then, searching in a memory section of the wireless mobile device for a permissible receiving frequency, by successively testing permissible receiving frequencies until a permissible receiving frequency that can be used by the wireless mobile device is found; receiving a third up-frequency from a wireless station device that sent the third up-frequency using the permissible receiving frequency; judging whether or not the third up-frequency is a permissible sending frequency, and if it is permissible, sending the terminal registration to the wireless station device that sent the third up-frequency.

Also, if the last-used receiving frequency and any of the down-frequencies of the peripheral stations cannot be used by the wireless mobile device, then, the subsequent steps presented above may be replaced with the following steps: searching for a receiving frequency that can be used by the wireless mobile device, by successively testing permissible receiving frequencies so as to find a station device whose down-frequency matches a permissible receiving frequency for the wireless mobile device, beginning with a down-frequency shared by the highest number of station devices until a receiving frequency that can be used by the wireless mobile device is found; receiving a third up-frequency from a station device using the receiving frequency; checking whether or not the third up-frequency received is a permissible sending frequency; and if it is permissible, sending the terminal registration to the wireless station device that sent the third up-frequency.

Further, the above program may directly proceed to the step of: searching for a receiving frequency that can be used by the wireless mobile device, by successively testing permissible receiving frequencies so as to find a wireless station device whose down-frequency matches a permissible receiving frequency for the wireless mobile device, beginning with a down-frequency shared by the highest number of wireless station devices until a receiving frequency that can be used by the wireless mobile device is found; receiving an up-frequency from a wireless station device using the receiving frequency; checking whether or not the up-frequency received is a permissible sending frequency; and if it is permissible, sending the terminal registration to the wireless station device that sent the up-frequency.

Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described herein.

The present document claims the benefit of the earlier filing dates of JP 10-262099 filed Sep. 16, 1998, JP 10-294592, filed Sep. 30, 1998, JP 10-309228, filed Oct. 29, 1998, JP 10-309231, filed Jun. 29, 1998, and JP 10-361659, filed Dec. 18, 1998, the entire contents of each of which being incorporated herein by reference.

What is claimed is:

1. A wireless server system, for wirelessly connecting a terminal unit having a terminal device and a wireless mobile device to Internet, comprising:

at least one wireless server, including a home server for said wireless mobile device, configured to communicate information via the Internet; and

a plurality of wireless station devices connected to said at least one wireless server and configured to conduct wireless communication with a terminal unit by way of said wireless mobile device, wherein

said home server being within a communication range district of said plurality of wireless station devices, said terminal device being configured to communicate over the Internet by way of said wireless mobile device.

2. A wireless server system according to claim **1**, wherein each wireless server of said at least one wireless server comprising:

a terminal approval managing section configured to allow the wireless mobile device to be connected to a predetermined wireless server of the at least one wireless server, by approving said wireless mobile device for connection in response to a terminal registration request sent from said wireless mobile device; and

a terminal managing section configured to issue to said wireless mobile device an IP address available for use at a time of connecting said wireless mobile device to said predetermined wireless server of the at least at least one wireless server, and configured to register a connection of said mobile device.

3. A wireless server system according to claim **2**, wherein:

said wireless server of the at least one wireless server, in response to a terminal registration request from said wireless mobile device for a connection to another wireless server that is not the home server, sends a request by way of the Internet to said home server to solicit a terminal approval and an IP address, and, when a terminal approval and an ID address are issued by said home server, approves a connection of said terminal unit to said another wireless server.

4. A wireless server system according to claim **3**, further comprising:

a packet routing section that is invoked when a wireless server that is not a home server of the terminal unit is supporting communications on behalf of the terminal unit and when packet data addressed to said terminal unit arrives at another wireless server that has previously supported communications on behalf of the terminal unit, said packet routing section being configured

to transfer said packet data to said presently communicating wireless server according to an IP address obtained from said home server.

5. A wireless server system according to claim 4, wherein:

when the wireless server that is not the home server for the terminal unit, and packet data addressed to said terminal unit is transferred to said terminal unit, a host server on the Internet that routed the packet data is configured to be advised of an identity of said proxy wireless server so that subsequent packet data are routed directly to said presently communicating wireless server without being sent to the another wireless server.

6. A wireless server system according to claim 1, wherein:

said at least one wireless server includes,

a broadcast information receiving section configured to receive information broadcast by way of a network connected to said at least one wireless server,

a broadcast level defining section having assigned broadcast levels for a plurality of terminal units for communicating with said at least one wireless server connected to said network, and

a broadcast information reconstruction section configured to reconstruct received information according to each broadcast level; and

said at least one wireless server being configured to distribute reconstructed received information prepared by said broadcast information reconstruction section to said plurality of terminal units.

7. A wireless server system according to claim 1, wherein:

said at least one wireless server includes,

a multi-cast information receiving section configured to receive multi-cast information by way of a network connected to said at least one wireless server;

a terminal information memory section having classifications and being configured to distribute multi-cast information to defined groups of terminal units; and

a destination deciding section configured to determine destinations for distributing multi-cast information according to said classifications.

8. A wireless server system according to claim 1, wherein:

said least one wireless includes,

a relay agent section so that, when it is necessary for a terminal unit presently communicating with said wireless server to receive an IP address from another wireless server, said relay agent section sends an IP address request made by said terminal unit to said another wireless server, and receives a reply packet from said another wireless server on behalf of said terminal unit.

9. A wireless server system according to claim 1, wherein:

said at least one wireless station device includes,

an IP address containing a same network address as a wireless server to which said wireless station device is connected so as to enable communication between said wireless server and said wireless station device using an Internet protocol.

10. A wireless, server system according to claim 1, wherein:

said at least one wireless station device includes,

a memory section configured to receive and store up-frequencies and down-frequencies of at least one of said plurality of wireless station devices and down-frequencies of a peripheral wireless station device received from an external source;

a read-only-memory section configured to store operational frequencies for sending and receiving data by said at least one of said plurality of wireless station devices; and

a judging section configured to compare up-frequencies and down-frequencies of said wireless station device stored in said memory section and operational frequencies stored in said read-only-memory section, so as to determine whether an operational frequency received from an external source is useable, wherein

when said judging section determines that said operational frequency is useable, said at least one of said plurality wireless station devices sends an up-frequency of said at least of said wireless station devices and a down-frequency of said peripheral wireless station device using a down-frequency of said at least one of said plurality of wireless station devices.

11. A wireless mobile device, connected to a terminal device of a terminal unit, for wirelessly connecting said terminal device to Internet by way of a wireless station device, comprising:

a memory section configured to store a last operational frequency used by said wireless mobile device and down-frequencies of a peripheral wireless station device;

a read-only-memory section configured to store permissible operational frequencies for sending and receiving data through said wireless mobile device; and

a judging section configured to compare frequencies stored in said memory section and permissible operational frequencies stored in said read-only-memory section so as to determine whether an operational frequency to be used by said wireless mobile device is useable, wherein

up-frequencies transmitted from said wireless station device are tested by successively using a last receiving frequency, said down-frequencies of said peripheral wireless station device and said permissible receiving frequencies so that a terminal registration request is transmitted only when an up-frequency received matches with a receiving frequency permitted for said wireless mobile device.

12. A wireless mobile device according to claim 11, further comprising:

a priority table generation section in the memory section configured to generate a priority table for efficiently selecting a receiving frequency from permissible receiving frequencies for said wireless mobile device, wherein

a receiving frequency that can be used as an up-frequency to send said terminal registration request can be selected from said permissible receiving frequencies with reference to said priority table.

13. A wireless mobile device, connected to a terminal device of a terminal unit, for wirelessly connecting said terminal device to Internet by way of a wireless station device, comprising:

a read-only-memory configured to store a plurality of permissible receiving frequencies and permissible sending frequencies, including a priority table generation section in a memory section configured to generate a priority table for efficiently selecting a receiving frequency from said permissible receiving frequencies; and

a judging section configured to compare operational frequencies of said wireless mobile device and operational

frequencies stored in said read-only-memory section, and judge whether a frequency to be used by said wireless mobile device is useable, wherein

a receiving frequency for receiving an up-frequency that can be used by said wireless mobile device to send a terminal registration request to said wireless station device is selected from said permissible receiving frequencies by consulting said priority table and successively testing receiving frequencies so as to receive an up-frequency sent from said wireless station device, and only when said up-frequency is a receiving frequency permitted for said wireless terminal unit, the terminal registration request is transmitted.

14. A wireless mobile device according to claim **13**, wherein:

said priority table is arranged in an order of a highest number of wireless station devices using same channels operating on same frequencies as permissible receiving frequencies of said wireless mobile device, according to a useable channel table defining useable channels for each wireless station device and a frequency table relating said useable channels to permissible receiving frequencies.

15. A method for wireless communication by performing a relay agent process in response to an IP address request made in a wireless server system for wirelessly connecting a terminal unit having a terminal device and a wireless mobile device to Internet, with at least one wireless server including a home server configured to communicate information via the Internet, a plurality of wireless station devices connected to said at least one wireless server and configured to conduct wireless communication with said terminal unit by way of said wireless mobile device, said home server being within a communication range district of said plurality of wireless station devices, said terminal device being configured to communicate over the Internet by way of said wireless mobile device, comprising the steps of:

receiving an IP address request sent from said wireless mobile device;

deducing the home server for said wireless mobile device according to a contents of said IP address request;

transmitting said IP address to said home server on behalf of said wireless mobile device;

receiving an IP address issued by said home server; and

distributing said IP address to said wireless mobile device.

16. A method of providing wireless communication between a wireless station device and a wireless mobile device, comprising the steps of:

receiving a first up-frequency provided by said wireless station device using a last receiving frequency of the wireless mobile device;

judging whether said first up-frequency is a permissible sending frequency for said wireless mobile device, so that, if said up-frequency is permissible, a step of sending a terminal registration request to said wireless station device using said first up-frequency is performed; however, if the last frequency is not useable other steps are performed, the other steps including,

receiving a second up-frequency from a peripheral wireless station device using a down-frequency allocated to said peripheral wireless station device,

judging whether said second up-frequency is a permissible sending frequency, and if said second up-frequency is permissible, sending the terminal registration request to said peripheral wireless station device using said second up-frequency; however, if said last receiving frequency and said second down-frequency of said peripheral wireless station device cannot be used by said wireless mobile device, then,

searching in a memory section of said wireless mobile device for a permissible receiving frequency for said wireless mobile device, by successively testing permissible receiving frequencies until a permissible receiving frequency that can be used by said wireless mobile device is found;

receiving a third up-frequency from a wireless station device that sent the third up-frequency using said permissible receiving frequency;

judging whether said third up-frequency is a permissible sending frequency, and if permissible, sending the terminal registration to said wireless station device that sent the third up-frequency.

17. A method of providing wireless communication between a wireless station device and a wireless mobile device, comprising the steps of:

receiving a first up-frequency provided by said wireless station device using a last receiving frequency of the wireless mobile device;

judging whether said first up-frequency is a permissible sending frequency for said wireless mobile device, so that, if said up-frequency is permissible a step of; sending a terminal registration request to said wireless station device using said first up-frequency is performed; however, if said last frequency is not useable other steps are performed, the other step including,

receiving a second up-frequency from a peripheral wireless station device using a down-frequency allocated to said peripheral wireless station device,

judging whether said second up-frequency is a permissible sending frequency; and if said second up-frequency is permissible, sending the terminal registration request to said peripheral wireless station device using said second up-frequency; however, if said last receiving frequency and said second down-frequency of said peripheral wireless station device cannot be used by said wireless mobile device, then, searching for a receiving frequency that can be used by said wireless mobile device, by successively testing permissible receiving frequencies so as to find a wireless station device whose down-frequency matches a permissible receiving frequency for said wireless mobile device, beginning with a down-frequency shared by a highest number of wireless station devices until a receiving frequency that can be used by said wireless mobile device is found; receiving a third up-frequency from a station device using said receiving frequency; checking whether the third up-frequency received is a permissible sending frequency; and if permissible, sending the terminal registration to the wireless station device that sent said third up-frequency.

18. A method for providing communication between a wireless station device and a wireless mobile device, comprising the steps of:

searching for a receiving frequency that can be used by said wireless mobile device by successively testing permissible receiving frequencies so as to find a wireless station device whose down-frequency matches a permissible receiving frequency for said wireless mobile device, said successively testing step including

beginning with a down-frequency shared by a highest number of wireless station devices until a receiving frequency that can be used by the wireless mobile device is found;

receiving an up-frequency from a wireless station device using said receiving frequency; and

checking whether said up-frequency received is a permissible sending frequency, and if the up-frequency is permissible, sending the terminal registration to said wireless station device that sent said up-frequency.

19. A computer program product, containing a terminal connection program for providing a terminal unit connecting process for a wireless server said wireless server includes a terminal approval managing section configured to allow a wireless mobile device to be connected to the wireless server, by approving said wireless mobile device for connection in response to a terminal registration request sent from said wireless mobile device, and a terminal managing section configured to issue to said wireless mobile device an IP address available for use at a time of connecting said wireless mobile device to said wireless server, and configured to register a connection of said mobile device, said terminal connection program effecting the steps of:

approving a wireless mobile device in response to a terminal connection request from said wireless mobile device; and

issuing an IP address presently available for use in response to an IP address request sent from said wireless mobile device.

20. A computer program product, containing a distribution program for broadcasting information divided into a classification of level groups for a wireless server, said wireless served includes a broadcast information receiving section configured to receive information broadcast by way of a network connected to a wireless server, a broadcast level defining section having assigned broadcast levels for a plurality of terminal units for communicating with the wireless server connected to said network, and a broadcast information reconstruction section configured to reconstruct received information according to each broadcast level, said at least one wireless server being configured to distribute reconstructed received information prepared by said broadcast information reconstruction section to said plurality of terminal units, said distribution program effecting the steps of:

receiving information broadcast to a network connected to the wireless server;

reconstructing the information received in said receiving step by consulting a broadcast level defining section having defined broadcast levels; and

distributing reconstructed broadcast information to a terminal device connected to said wireless server.

21. A computer program product, containing a distribution program for multi-casting information for a wireless server, said wireless server including a multi-cast information receiving section configured to receive multi-cast information by way of a network connected to said at least one wireless server, a terminal information memory section having classifications and being configured to distribute multi-cast information to defined groups of terminal units and a destination deciding section configured to determine destinations for distributing multi-cast information according to said classifications, said distribution program effecting the steps of:

receiving multi-cast information;

deciding distribution destinations of said multi-cast information, by consulting terminal information; and

distributing said multi-cast information according to distribution destinations thus determined in said deciding step.

22. A computer program product, containing a relay agent program for processing an IP address request for a wireless server, said wireless server including a relay agent section so that, when it is necessary for a terminal unit presently communicating with said wireless server to receive an IP address from another wireless server, said relay agent section sends an IP address request made by said terminal unit to said another wireless server, and receives a reply packet from said another network on behalf of said terminal unit, said relay agent program effecting the steps of:

processing an IP address request from said wireless mobile device;

deducing a home server of the said wireless mobile device according to contents of said IP address request;

issuing an IP address request to said home server on behalf of said wireless mobile device;

receiving an IP address issued by said home server; and

distributing said IP address received to said wireless mobile device.

23. A computer program product, containing an operational frequency selection program for a wireless mobile device, said wireless mobile device including a memory section configured to store a last operational frequency used by said wireless mobile device and down-frequencies of a peripheral wireless station device, a read-only-memory section configured to store permissible operational frequencies for sending and receiving data through said wireless mobile device, a judging section configured to compare frequencies stored in said memory section and permissible operational frequencies stored in said read-only-memory section so as to determine whether an operational frequency to be used by said wireless mobile device is useable, wherein up-frequencies transmitted from said wireless station device are tested by successively using a last receiving frequency, said down-frequencies of said peripheral wireless station device and said permissible receiving frequencies so that a terminal registration request is transmitted only when an up-frequency received matches with a receiving frequency permitted for said wireless mobile device, said operational frequency selection program effecting the steps of:

receiving a first up-frequency given by said wireless station device using a last receiving frequency of said wireless mobile device;

judging whether said first up-frequency is a permissible sending frequency for said wireless mobile device, so that, if said up-frequency is permissible, a step of sending a terminal registration request to said wireless station device using the first up-frequency is performed;

however, if said last frequency is not useable, performing steps of receiving a second up-frequency from a peripheral wireless station device using a down-frequency allocated to said peripheral wireless station device,

judging whether said second up-frequency is a permissible sending frequency, so that if said second up-frequency is permissible, a step of sending the terminal registration request to said peripheral wireless station device using said second up-frequency is performed;

however, if said last receiving frequency and said second down-frequency of said peripheral wireless station device cannot be used by said wireless mobile device,

then, performing a step of searching in a memory section of said wireless mobile device for a permissible receiving frequency, by successively testing permissible receiving frequencies until a permissible receiving frequency that can be used by said wireless mobile device is found;

receiving a third up-frequency from a wireless station device that sent the third up-frequency using said permissible receiving frequency; and

judging whether the third up-frequency is a permissible sending frequency, and if it is permissible, sending the terminal registration to said wireless station device that sent the third up-frequency.

24. A computer program product, containing an operational frequency selection program for a wireless mobile device, said wireless mobile device includes a priority table generation section in a memory section configured to generate a priority table for efficiently selecting a receiving frequency from permissible receiving frequencies for said wireless mobile device, a receiving frequency that can be used as an up-frequency to send a terminal registration request can be selected from said permissible receiving frequencies with reference to said priority table, said operational frequency selection program effecting the steps of:

receiving a first up-frequency given by said wireless station device using a last receiving frequency of the wireless mobile device;

judging whether said first up-frequency is a permissible sending frequency for said wireless mobile device, so that, if said first up-frequency is permissible, a step of sending a terminal registration request to said wireless station device using the first up-frequency is performed; however, if the last-used frequency is not useable, steps of

receiving a second up-frequency from a peripheral wireless station device using a down-frequency allocated to said peripheral wireless station device, and

judging whether said second up-frequency is a permissible sending frequency are performed;

and if said second up-frequency is permissible, sending the terminal registration request to said peripheral wireless station device using said second up-frequency; however, if said last receiving frequency and said second down-frequency of said peripheral wireless station device cannot be used by said wireless mobile device, then, additional steps are performed including searching for a receiving frequency that can be used by said wireless mobile device, by successively testing permissible receiving frequencies so as to find a wireless station device whose down-frequency matches a permissible receiving frequency for said wireless mobile device, beginning with a down-frequency shared by the highest number of wireless station devices until a receiving frequency that can be used by said wireless mobile device is found; receiving a third up-frequency from a station device using said receiving frequency; checking whether the third up-frequency received is a permissible sending frequency; and if permissible, sending the terminal registration to the wireless station device that sent said third up-frequency.

25. A computer-readable recording medium, containing an operational frequency selection program for the wireless mobile device, said wireless mobile device including a read-only-memory configured to store a plurality of permissible receiving frequencies and permissible sending frequencies, including a priority table generation section in a memory section configured to generate a priority table for efficiently selecting a receiving frequency from said permissible receiving frequencies; a judging section configured to compare operational frequencies of said wireless mobile device and operational frequencies stored in said read-only-memory section, and judge whether a frequency to be used by said wireless mobile device is useable, wherein a receiving frequency for receiving an up-frequency that can be used by said wireless mobile device to send said terminal registration to said wireless station device is selected from said permissible receiving frequencies by consulting said priority table and successively testing receiving frequencies so as to receive an up-frequency sent from said wireless station device, and only when said up-frequency is a receiving frequency permitted for said wireless terminal unit, a terminal registration is transmitted, said operational frequency selection program effecting the steps of:

searching for a receiving frequency that can be used by said wireless mobile device, by successively testing permissible receiving frequencies so as to find a wireless station device whose down-frequency matches a permissible receiving frequency for said wireless mobile device, beginning with a down-frequency shared by the highest number of wireless station devices until a receiving frequency that can be used by the wireless mobile device is found;

receiving an up-frequency from a wireless station device using said receiving frequency;

checking whether or not said up-frequency received is a permissible sending frequency; and

if permissible, sending the terminal registration to the wireless station device that sent said up-frequency.

26. A wireless server system, for providing wireless communications connectivity between a terminal unit having a terminal device and a wireless mobile device to Internet, comprising:

means for relaying information between the terminal unit and Internet, said means for relaying information including at least one wireless server, including a home server for said wireless mobile device;

means for interconnecting said at least one wireless server and said terminal unit, wherein said home server being within a communication range district of said means for interconnecting, said terminal device being configured to communicate over the Internet by, way of said wireless mobile device;

means for receiving an IP address request sent from said wireless mobile device;

means for deducing the home server for said wireless mobile device according to a contents of said IP address request;

means for transmitting said IP address to said home server on behalf of said wireless mobile device;

means for receiving an IP address issued by said home server; and

means for distributing said IP address to said wireless mobile device.

27. A wireless mobile device, connected to a terminal device of a terminal unit, for wirelessly connecting said terminal device to Internet by way of a wireless station device, comprising:

means for storing a last operational frequency used by said wireless mobile device and down-frequencies of a peripheral wireless station device;

means for storing permissible operational frequencies for sending and receiving data through said wireless mobile device; and

means for comparing frequencies stored in said memory section and permissible operational frequencies stored in said means for storing permissible operational frequencies so as to determine whether an operational frequency to be used by said wireless mobile device is useable, wherein

up-frequencies transmitted from said wireless station device are tested by means for successively using a last receiving frequency, said down-frequencies of said peripheral wireless station device and said permissible receiving frequencies so that a terminal registration request is transmitted only when an up-frequency received matches with a receiving frequency permitted for said wireless mobile device.

28. A wireless communications device comprising:

means for receiving a first up-frequency provided by a wireless station device using a last receiving frequency of a wireless mobile device;

means for judging whether said first up-frequency is a permissible sending frequency for said wireless mobile device, so that, if said up-frequency is permissible, means for sending a terminal registration request to said wireless station device using said first up-frequency is invoked; however, if the last frequency is not useable other mechanisms are invoked including,

means for receiving a second up-frequency from a peripheral wireless station device using a down-frequency allocated to said peripheral wireless station device,

means for judging whether said second up-frequency is a permissible sending frequency, and if said second up-frequency is permissible, sending the terminal registration request to said peripheral wireless station device using said second up-frequency; however, if said last receiving frequency and said second down-frequency of said peripheral wireless station device cannot be used by said wireless mobile device, then other mechanisms are invoked including,

means for searching in a memory section of said wireless mobile device for a permissible receiving frequency for said wireless mobile device, by successively testing permissible receiving frequencies until a permissible receiving frequency that can be used by said wireless mobile device is found,

means for receiving a third up-frequency from a wireless station device that sent the third up-frequency using said permissible receiving frequency,

means for judging whether said third up-frequency is a permissible sending frequency, and if permissible, invoking means for sending the terminal registration to said wireless station device that sent the third up-frequency.

29. A system for providing communication between a wireless station device and a wireless mobile device, comprising:

means for searching for a receiving frequency that can be used by said wireless mobile device including means for successively testing permissible receiving frequencies so as to find a wireless station device whose down-frequency matches a permissible receiving frequency for said wireless mobile device, said means for successively testing beginning with a down-frequency shared by a highest number of wireless station devices until a receiving frequency that can be used by the wireless mobile device is found;

means for receiving an up-frequency from a wireless station device using said receiving frequency; and

means for checking whether said up-frequency received is a permissible sending frequency, and if the up-frequency is permissible, sending the terminal registration to said wireless station device that sent said up-frequency.

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